SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY 1909.

GENERAL PHYSICS.

1. *Spirit-levels.* **J. Bonsdorff.** (Mitt. d. Nikolai-Hauptsternwarte zu Pulkowo, 2. p. 48, 1907. Zeitschr. Instrumentenk. 28. pp. 344–346, Nov., 1908. Abstract.)—A paper discussing the movement of the air-bubble in spirit-levels. Four levels were dealt with, three of which were very sensitive. The motion of the bubble is similar to that of a strongly damped pendulum. With the three very sensitive levels the motion was aperiodic, but with the fourth the motion was periodic, and the period increased as the length of the bubble diminished. The equation for damped vibrations is discussed, and the various constants are determined for the particular levels dealt with.
A. W.

2. *Instrument for Determination of Time.* **S. de Glasenapp.** (Soc. Astronom. de France, Bull. p. 488, Nov., 1908. Nature, 79. p. 108, Nov. 26, 1908. Abstract.)—Description of a new *cercle solaire* invented by the author for accurately determining time. The instrument consists of a metal cylinder 4 in. diam. and ½ in. high, suspended vertically, and adjustable in azimuth. A conical hole is drilled through one wall, and an image of the sun is projected through this hole on to an arbitrary scale along the opposite side of the cylinder. The time of coincidence with any particular point on the scale is noted before noon, and the time noted with a watch, then the time when the same scale value is again occupied by the solar image after noon is noted. By suitable reduction the time of noon can be determined to within 40 sec.
C. P. B.

3. *Averaging Instrument for Polar Diagrams.* **W. F. Durand.** (Amer. Soc. Mech. Engin., Journ. 30. pp. 1241–1246, Mid-Oct., 1908.)—Many dial-recording gauge instruments now in use trace a diagram in polar co-ordinates. With an ordinary planimeter only the mean square of the radius of such a diagram can be obtained, and this, of course, will not give the mean radius on taking the square root. The present paper describes a simple instrument for determining directly the value of the mean radius of a polar curve. Let O be the centre, and at O let a socket be pivoted so as to permit

a rod PQ to slide freely back and forth as required for the tracing-point P to follow the curve AB. The rod PQ carries a wheel W whose axis is parallel to PQ and which is graduated in the same general manner as the integrating wheel of a planimeter. Then it is clear that the wheel W can respond to movement in angle only, and that the movement of the rod PQ radially, or in the direction of its own length, will produce no movement of the wheel. The motion of the wheel will be proportional to the radius WO, which differs from PO by a constant distance PW $= a$. Hence the final movement of the wheel will be proportional to the product of the angle AOB and the mean radius for the curve between these points, which can thus be readily obtained. In the usual form of gauge instrument the marking-point moves on the arc of a circle, but the above averaging instrument can still be used if the tracing-point P, after traversing the curve AB, is brought back along the gauge instrument curve to a point at the same distance from the centre as the point A. A. W.

4. *A New Hair Hygrometer.* **N. Russeltvedt.** (Meteorolog. Zeitschr. 25. pp. 396–400, Sept., 1908.)—This is a torsion instrument in which the effect produced by the change in length of two horse hairs is balanced against the torsion produced by two twisted silk threads. The special advantages claimed for the apparatus are (1) complete absence of friction; (2) the horse hairs are comparatively strong and, as the torsional forces are small, they do not get strained or broken, as is so often the case with human hair; (3) the pointer can be adjusted so that a change of humidity of 1 per cent. produces the same movement at all points of the scale; (4) the instrument is practically compensated for temperature. The instrument has been constructed at the request of H. Mohn, the Director of the Norwegian Meteorological Institute. R. G. K. L.

5. *Variometer for Measuring the Vertical Velocity of Balloons.* **A. Bestelmeyer.** (Phys. Zeitschr. 9. pp. 863–864, Dec. 1, 1908. Paper read before the 80. Naturforscherversamml., Köln.)—The author showed and described briefly a modification of the Hefner-Alteneck variometer made by Spindler and Hoyer, of Göttingen. When the balloon rises and the atmospheric pressure is reduced, air escapes from the variometer vessel through a capillary tube, and the air pressure within the vessel is also reduced; friction of the air in the capillary retards this latter diminution, however. The retardation is indicated by the petroleum manometer attached to the vessel, and is proportional to the rate of relative change in the air pressure. H. B.

6. *Behaviour of Stretched Liquids.* **E. Ramstedt.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 16. pp. 1–16, 1908.)—The author describes experiments made to measure the tension to which various liquids can be subjected before they split. The method used was that of Worthington (Roy. Soc., Phil. Trans. 183A, p. 355, 1892) and Berthelot (Ann. Chim. Phys. 30. p. 232, 1850), the liquid being enclosed in a tube having one end drawn out into a fine spiral, by the rotation of which the pressure within the tube could be measured. With water, very variable numbers were obtained for the maximum negative pressure possible before splitting occurs, the highest values being given when the liquid is cooled slowly and when little streaming takes place in it. With alcohol, a negative pressure of 10–12 atmos. is easily obtainable (compare Worthington, *loc. cit.*). With ether very variable results are obtained, owing probably to a small amount of air absorbed by the walls

of the vessel. The lower values for ether may be accounted for by the lower adhesion between ether and glass than between water and glass; it may be however, that there is more adsorbed air in the former case than in the latter. The presence of ions in the liquid has no influence on the stretching, which latter has no effect on the degree of electrolytic polarisation. Further, the accumulation of ions at the electrodes occurring during polarisation has no influence on the stretching of the liquid. **T. H. P.**

7. *Behaviour of Metals under Combined Stresses.* **E. L. Hancock.** (Phil. Mag. 16. pp. 720–725, Nov., 1908. Paper read before the Amer. Soc. for Testing Materials, June, 1908.)—The three theories used in the design of structures subjected to combined tension (or compression) and shear are briefly discussed. First, that which holds that the material will fail where the tensile or compressive stress is a maximum leads to the formula—

$$q=\tfrac{1}{2}[p\pm\sqrt{(p^2+4p_s^2)}].$$

Second, that in which the criterion of failure is taken as the loading for which the max. tensile or compressive strain exceeds a certain limit results in the formula $q=\tfrac{3}{8}p\pm\tfrac{5}{8}\sqrt{(p^2+4p_s)}$. This depends on the assumption that Poisson's ratio is 0·25, which does not agree closely with experimental results. Third, taking the occurrence of a limiting shear stress q as the criterion, the formula $q=\sqrt{(p^2+b^2p_s^2/a^2)}$ is obtained. This is recommended as being in better agreement than either of the preceding with the results of tests by the author, Scoble, and Guest [see Abstracts. Nos. 1809 (1906), 6 (1907), and 1400 (1908)]. The equivalent twisting moment in this case is M, given by $M^2=M_2^2+(4a^2/b^2)M_1^2$. M_2 is the twisting moment, M_1 the bending moment, q the greatest shear stress, p and p_s are the tensile (or compressive) and shear stresses due to the direct and shear loads respectively, b and a are the tensile (or compressive) and shear elastic limits respectively. **F. R.**

8. *Axially Loaded Hollow Cylinders.* **R. Lorenz.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1706–1718, Oct. 24, 1908.)—A mathematical treatment. The following general equation is obtained for the deformation of a thin-walled hollow cylinder under a load P uniformly and symmetrically distributed about, and parallel to the axis—

$$\frac{d^4u}{dz^4}+\frac{6P}{\pi E r_m h^3}\frac{d^2(u+u_o)}{dz^2}+\frac{12u}{r_m^2h^2}-12\frac{r_af_a-r_if_i}{Er_mh^3}=0.$$

u is deflection measured radially; u_o any initial deflection; z the radial co-ordinate; r_m the mean, r_i the internal, and r_a the external radius; h the thickness; f_a, f_i the external and internal longitudinal stress respectively, and E is Young's modulus. The buckling of thin cylinders is analysed, the lowest buckling load being $2\pi Eh^2/\sqrt{3}$, which is thus only dependent on the thickness and modulus of elasticity. The analysis of the wave-length of crumpling at the first buckling load does not permit of brief condensation; the wave-length, however, is found to depend only on the mean radius and thickness. Reference is made to the paper dealt with in Abstract No. 375 (1908). Finally, the author deals with externally ribbed cylinders and arrives at formulæ for the stresses. **F. R.**

9. *Activity of the Royal Depôt for Testing Materials in* 1907. (Königl. Materialprüfungsamt, Mitt. 26. 5 and 6. pp. 209–307, 1908.)—The coefficient of static friction of metals is slightly greater than that of sliding. The lowest

values for worked surfaces are from 0·11 to 0·18, for bronze to bronze or steel, and the highest from 0·21 to 0·27 for cast iron to mild or cast steel. Results obtained with unworked surfaces are summarised and will shortly be published in full. Gall driving chains for motor cars, of 3·5 cm. links, and from 2·31 to 3·38 kg. weight per m., made by various factories, had tensile strengths from 3,380 to 7,750 kg., fracture always occurring through the eye. Tensile and shock and static bending tests on the materials gave concordant results. Electrically-welded crane chains, made of steel rod from 0·7 to 1·8 cm. diam., broke with stresses ranging from 3,030 to 2,440 kg. per cm.². In two cases fracture did not occur at the weld, and yet the strength was not abnormally low. The position of the weld in these chains could not be detected when new, but in another series in which the weld was at the neighbourhood of contact of adjacent links the breaking stresses in chains made of from 0·4 to 0·8 cm. diam. rod were from 2,810 to 2,840 kg. per cm.², and fracture occurred about as frequently at the weld as elsewhere. The following results show the alteration of properties in metals at 200° C., as compared with atmospheric temperature :—

	Temperature.	Elastic limit, kg. per cm.².	Tensile strength, kg. per cm.².	Elongation per cent.
Open-hearth steel castings	Atmospheric	—	3,900–4,550	10·8–29·4
	200° C.	—	4,350–5,430	7·7–14·4
Copper tube	Atmospheric	260–320	2,090–2,210	50·5–50·7
	200° C.	250–270	1,540–1,550	43·8–44·5

Comparisons of the strengths of hard-drawn Al and copper electrical transmission wires gave the following figures :—

	Elastic limit, kg. per cm.².	Tensile strength, kg. per cm.².	Elongation per cent.	Elastic limit / Tensile strength.
Copper wires 0·1 to 0·8 cm. diam.	2,460–4,840	2,900–5,220	1·6–9·9	0·85–0·99
Al wires 0·2 to 0·4 cm. diam.	1,350–1,750	1,720–2,040	3·3–7·1	0·68–0·92

Further results of the comparative tests on hammer-forged and hydraulically pressed steel pipe flanges are mentioned. The following are results of tests of bond between concrete and reinforcing rods, the load required to pull the rods out being expressed in kg. per cm.² of contact surface (about equal in all cases, the circumferences being from 5·76 to 6·4 cm.) except in the case of the bulbed bar which is total load in kg. :—

Concrete Mixture.	1:3.	1:5.	1:7.
Bulbed	5,570	5,030	2,920
Flat	27·8	15·1	4·7
Square.......................................	27·3	15·4	9·5
Round.......................................	31·8	18·4	8·2

The bursting pressure of a drawn brass tube of 0·6 cm. (external) square section and 0·015 cm. thickness was 43·6 atmos. at atmospheric temperature, and 22·8 atmos. at 90° C. Boiler water-gauge glass tubes burst at from 12 to 24·5 atmos. pressure. The difference in the rates of corrosion of iron according to the amount of cold work, *e.g.*, wire-drawing, it has undergone, is being studied experimentally. The corrosion of drawn brass condenser tubes probably occurs the more rapidly because the material is in a severely cold-worked condition. Cracks in a nickel steel were found to have been caused by forging at too high a temperature, and radial cracks at the bottom corners of the teeth of a hardened chrome-nickel steel toothed wheel show the liability of steels of this class to contraction cracks. A number of minor instances of applications of metallography are mentioned. The principal metallographic and metal-testing papers emanating from the Depôt have already been abstracted. The work of the other sections (building materials, paper and textiles, general chemistry, and oil testing) is also reviewed. F. R.

10. *Stresses in Blackwell's Island* (*Queensboro*) *Bridge.* (Eng. News, 60. pp. 557–560, Nov. 19, 1908.)—A diagram and table of stresses in the most severely overstressed spans of the bridge under full specified loading are given. The specifications permitted 39,000 lbs. per sq. in. tension on nickel steel eye-bars, and 24,000 lbs. per sq. in. tension on riveted or eye-bar carbon steel members, as "congested" loading, and 30,000 and 20,000 lbs. per sq. in. respectively as normal working stresses. It appears that several members are stressed to 45 to 47 per cent. in excess of the "congested" limits. The greatest stresses on compression members are 26,800 lbs. per sq. in. on a chord member and 25,800 lbs. per sq. in. on a web member. At the same time some members are only stressed to 4,600 lbs. per sq. in., and it is considered that the 25 per cent. of increase in dead weight during construction is largely accounted for by metal wasted on these unnecessarily large members. F. R.

11. *Matter and Energy: a Revision.* **G. N. Lewis.** (Phil. Mag. 16. pp. 705–717, Nov., 1908. Technology Quarterly, 21. pp. 212–225, June, 1908. Contribution from the Research Laborat. of Phys. Chem.)—Assume the conservation of energy, of mass, and of momentum. A black body in a beam of light experiences a pressure f; if V be the velocity of light, E the energy received, $f=(dE/dt)/V$. It will also acquire momentum M at the rate $(dM/dt)=f$. Therefore $dE/dM=V$; hence for the beam itself or any part of it $E/M=V$; *i.e.*, something possessing mass probably moves with the velocity of light and has energy and momentum. Assume this conclusion to be correct; then a body receiving radiation acquires this mass as well as the momentum and energy of the radiation, and it therefore increases in mass. Since $M=mV$, m being the mass in question, $dM=Vdm$; whence $dm=dE/V^2$ or $1{\cdot}111\times10^{-21}$ gm. for every erg. A corresponding gain or loss of mass must accompany every gain or loss of any form of energy by a body, whatever the process by which energy is gained or lost. Assume that if a body lost all its energy it lost all its mass; then $m=E/V^2$, a result also reached by Einstein [Abstract No. 188 (1906)] from the electromagnetic theory, while Comstock [Abstract No. 484 (1908)] has from electromagnetic theory deduced $m=(4/3)E/V^2$. The preceding equations give $E=mV^2$ instead of $E=mV^2/2$ for mass m moving with velocity V; but we shall see that there is no inconsistency. Let us surrender the Newtonian axiom that mass is independent of velocity; a body gaining in kinetic energy then increases in mass, while some other system losing the same energy loses the same mass. A body with

momentum M is brought to rest in M seconds by a constant retarding force of one dyne; $dM = f \,.\, dt$. A body with kinetic energy E′ will travel E′ cm. before being brought to rest by a constant retarding force of one dyne; $dE' = f \,.\, dl = f \,.\, v \,.\, dt$ if the body be moving with velocity v. Hence $dE' = v \,.\, dM$; but $M = mv$, and m is to be treated as a variable; whence $dE' = mv \,.\, dv + v^2 \,.\, dm$. But (*supra*) $dE' = V^2 \,.\, dm$, whence $V^2 \,.\, dm = mv \,.\, dv + v^2 \,.\, dm$. This gives $\log m = -\frac{1}{2}\log(1 - (v/V)^2) + \log m_0$, where $\log m_0$ is the integration constant; whence $m/m_0 = (1 - \beta^2)^{-\frac{1}{2}}$, where $\beta = v/V$, the ratio of the velocity of the body to the velocity of light, and m_0 is the limiting value of the mass when the velocity of the body, v, $= 0$. Under this equation, m/m_0 is very nearly equal to unity even for very high values of v, but becomes infinite when $v = V$, the velocity of light. The fastest cannon ball could only gain a one-million-millionth part in weight through the kinetic energy imparted to it. For ordinary cases the Newtonian axioms therefore hold good; but in negative particles emitted by radio-active substances we have velocities only a little less than that of light. Assume that the charge e in these is constant, the variations of e/m with the speed v must be due to variations in m; whence the values of m/m_0 at the different velocities can be calculated from the equation $m/m_0 = (1 - \beta^2)^{-\frac{1}{2}}$. The observed results (Kaufmann) agree remarkably with the calculated in their trend. The variation of "electromagnetic mass" with velocity (J. J. Thomson and Heaviside) leads on Abraham's theory (electrons = rigid spheres) to the equation $m/m_0 = \frac{3}{4}\frac{1}{\beta^2}\left(\frac{1+\beta^2}{2\beta}\log\frac{1+\beta}{1-\beta} - 1\right)$, on Bucherer's (electrons = spherical at rest, but contract in the direction of their motion and expand laterally, retaining the same volume) to the equation $m/m_0 = (1 - \beta^2)^{-\frac{1}{3}}$, and on Lorentz's (electrons similar to Bucherer's but not expanding laterally) to the equation $m/m_0 = (1 - \beta^2)^{-\frac{1}{2}}$, the same as the author's equation for ordinary mass. There is no need for the conception of an "electromagnetic mass" distinct from ordinary mass, if we give up assuming that the ordinary mass is independent of the velocity. From $m - m_0 = E'/V^2$ and $m/m_0 = (1 - \beta^2)^{-\frac{1}{2}}$ we get $E' = mV^2[1 - (1 - \beta^2)^{\frac{1}{2}}]$, the general formula for the kinetic energy of a moving body. Expanding this we have—

$$E' = mV^2(\tfrac{1}{2}\beta^2 + \tfrac{1}{8}\beta^4 \ldots).$$

For low values of $\beta = v/V$ this becomes $E = \frac{1}{2}mv^2$, the Newtonian equation, for $v = V$, $\beta = 1$ and $E = mV^2$, as in the equation for a beam of light above. But now, in a beam of light, whatever it is that travels, if it had any finite mass m_0 when at rest, it would have infinite mass at velocity V; therefore when at rest, or even at a velocity by the smallest fraction less than that of light, it has no finite mass m_0, no energy, no momentum. It is therefore not matter in the ordinary sense. A mere ether drift, if light were due to travel of an ether at velocity V, could in no way affect a beam of radiation. A body absolutely at rest would be capable of being accelerated, by a given force, equally in all directions. It is proposed to show in a further paper that the theory harmonises with the accepted theories of light. A. D.

12. *Indestructibility of Matter and Absence of Exact Relations among the Atomic Weights.* **D. F. Comstock.** (Chem. News, 98. pp. 178–179, Oct. 9, 1908.)—According to the electrical theory of matter, which considers the atoms as systems composed of electric charges, the mass of a piece of matter is determined solely by, and is proportional to, the amount of electromagnetic energy which it contains. It follows from this that the inertia or mass is really a property of the energy stored up within the structure which defines the space relations of a piece of matter, and is not a property of the structure itself. Hence the law of conservation of mass, which is probably only approximate, is in reality a corollary to the law of conservation of energy. Any loss of energy must therefore involve a diminution of mass. Thus, when a chemical reaction which liberates heat has taken place, when a body is cooled, or when by a process of radio-activity one substance loses energy and is transformed into another substance, there must be a decrease in the total mass and hence in the weight. In the first two cases, however, the change is too small to be detected, but in the last case the change should be appreciable and gives a ready explanation of the irregularities occurring in the table of atomic weights. Finally, it is pointed out that, since gravity is proportional to mass, it would appear that gravitation must be considered as acting between quantities of confined energy and not between masses in any other sense. T. H. P.

13. *Steady Motion of Liquids.* **W. McF. Orr.** (Roy. Irish Acad., Proc. 27. pp. 9–68, March, and pp. 69–138, Oct., 1907.)—A lengthy mathematical discussion of the question of the stability or instability of the steady motions of a perfect liquid and of a viscous liquid. The first part deals entirely with perfect liquids. Cases of motion in plane strata are first discussed. A brief outline is given of Rayleigh's investigation of the fundamental free disturbances, reference being made to Kelvin's objection and to Rayleigh's reply thereto. Love's criticisms of these investigations are next considered. The solution obtained is examined and various conclusions drawn. It is pointed out that the co-existence of the stability or neutrality in the case of each of the fundamental modes of disturbance, with what may be described as practical instability for others of a more general type, is quite in keeping with Fourier's analysis; that the question of the stability of a state of equilibrium is in reality decided by a potential-energy criterion; and that the light thrown on the question by a knowledge of the reality of the "free periods" is only indirect. The flow in cylindrical strata, through a pipe whose section is a circle, or an annulus between two concentric circles, is next treated. Rayleigh's discussion is again followed. The only case which is at all tractable is that in which the law of velocity in the steady motion is that appropriate to a viscous liquid in a complete circular pipe, and only for disturbances symmetrical about the axis. As in the case of plane strata, each fundamental mode involves slipping in the interior of the liquid and at the boundaries. A brief discussion is given of steady motion in cylindrical strata, rotating around a common axis. It is held that, as far as this investigation goes, no contradiction is revealed between theory and experiment. In the second paper the effect of viscosity is discussed, following the works of Rayleigh and Kelvin. Finally, the method of Osborne Reynolds is applied to some special cases, and numerical results are obtained which differ from those obtained by Lorentz, Reynolds, Sharpe, and others. These differences are discussed. It is pointed out that the general result obtained by all is that, up to a certain velocity, the motion is certainly stable, and the frictional resistance varies as the velocity; beyond this comes a region in which the motion at times appears to be stable and at other times to be unstable, the average resistance on the whole now increasing more rapidly than the first power of the velocity; if the velocity is still further increased, the motion is permanently eddying and turbulent, and the resistance is, approximately at least, proportional to the square of the velocity. A. W.

14. *Formation of Centres of Gyration in Liquids at the Back of an Object in Motion.* **H. Bénard.** (Comptes Rendus, 147. pp. 839–842, Nov. 9, 1908.)—The author has observed, by means of a kinematographic arrangement, the movements of a liquid at the rear of a moving solid body partially immersed vertically therein, having a plane of symmetry at right angles to the direction of translation, and a more or less acute angle in front. The vortices periodically separate themselves alternately from the right and from the left of the back swell which follows the solid, almost immediately arranging themselves in a double row, those on the right dextrogyrate, those on the left lævogyrate, and at an equal distance apart, which is independent of the velocity of the solid body, but increases approximately as the square root of its transverse thickness, and in the same sense as the viscosity of the liquid, but more slowly. The speed of rotation diminishes with decreased velocity of the solid body, and also with greater viscosity of the liquid. W. H. Si.

15. *Effect of Friction on the Vibrations of a Sphere filled with Liquid.* **R. Ladenburg.** (Ann. d. Physik, 27. 1. pp. 157–185, Sept. 25, 1908. Physikal Inst. d. Univ., Breslau, Aug., 1908.)—Whilst the coefficient of viscosity has a definite value for any given liquid, the coefficient of external friction between liquid and solid has in nearly all cases examined an infinite value. Helmholtz and Piotrowski by observations of the period and decrement of an oscillating glass vessel filled with water found that the decrement was lessened when the surface of the glass was silvered. Helmholtz then elaborated a theory in which the sliding coefficient, or ratio of the coefficients of external and internal friction, had a value greater than zero. Piotrowski's experiments gave the value 0·285 for water-gold. The value deduced for the coefficient of viscosity of water differed, however, by about 40 per cent. from the accepted value, and Whetham's experiments made in 1890 did not confirm the existence of the sliding coefficient. On repeating Piotrowski's experiments with a hollow ball filled with water, making torsional vibrations about a vertical axis, it was found that silvering the inner surface produced no effect on the period and decrement. Helmholtz's theory for infinitely great external friction was applied and the coefficient of viscosity of water thus determined, viz., 0·01065 at 17·5° C., agreed with that found by other observers. G. E. A.

16. *Studies of Atmospheric Vortices. III. The Truncated Dumb-bell Vortex of the St. Louis, Mo., Tornado of May* 27, 1896. **F. H. Bigelow.** (Monthly Weather Rev. 36. pp. 245–250, Aug., 1908.)—The author analyses the records compiled by H. C. Frankenfield at the Weather Bureau station and by others. At the station the barometer was 29·25 in. at noon, temperature 78° F., 29·22 in. and 84° at 2 p.m., 28·97 in. and 72° at 6 p.m., 28·74 at 6·20 p.m., 29·14 in. at 6·30 p.m., 29·05 in. and 67° at 7 p.m.; the vortex was central about 6·15 p.m. and passed west to east. In Lafayette Park, apparently in the centre of the track, the barometer went down to 26·65 in. The chief damage was done in the upper stories of buildings and at heights above 30 ft.; the lower stratum was probably protected by the buildings. Owing to the great dimensions of the tornado enormous volumes of air seem to have been uplifted, 47 times as much as at Cottage City [see Abstract No. 752 (1908)]. The cause of the tornado was that a cold mass of air was carried over the the stagnant air of the city. Instead of mixing with the cold sheet the warm air slid out horizontally in all directions, radially from the point of greatest temperature contrast. H. B.

17. *Air-resistance of Surfaces Parallel to the Direction of Motion.* **A. Frank.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1522–1528, Sept. 19, 1908.)—The pendulum employed in previous experiments [see Abstract No. 1008 (1906)], has suspended from it an arrangement by means of which a variable number of parallel metal plates can be fixed to the lower end, the oscillations of the pendulum taking place only in the direction of the length of the plates. The surface constant κ for such plates is determined and is given by $\kappa = 0{\cdot}575 - 44\beta + 1084\beta^2$, where β is the uniform distance between the plates in metres. The value of β varied from 0·008 to 0·012. The air-resistance of airships is finally considered and the value $8{\cdot}58\gamma v^2/g$ found for the resistance of the cylindrical surface. Further, a plane surface of length l metres, moving in still air parallel to its own plane, disturbs the air to a distance of $0{\cdot}0004 + l/80$ metres from it. Assuming that the total resistance depends on the mass of air set in motion, it is calculated that the resistance of a cigar-shaped body is greater than that of a cylinder of equal volume by $5{\cdot}23\gamma v^2/g$, the ends of both bodies being similar ellipsoids. This is a much greater difference than that between the resistances of the side surfaces of the two bodies, and therefore the form of the long cylinder chosen by v. Zeppelin appears to be the correct one. G. E. A.

18. *Motion of Air at Potsdam* (1894–1900). **O. Meissner.** (Meteorolog. Zeitschr. 25. pp. 400–409, Sept., 1908.)—The paper contains a complete discussion of the hourly tabulations of the Robinson cup anemometer at Potsdam for the years specified. The average monthly velocity shows a maximum, 6·28 m./sec. in Dec., and a minimum, 4·86 m./sec. in May. From May to Aug. it scarcely changes; it rises slowly from Aug. to Oct. (5·15) and then more rapidly to the maximum; in spring it shows a rapid decrease after March (5·88). The absolute extreme hourly velocity was 21·9 m./sec. (49 miles per hour). The average hourly velocity exhibits a small but well-marked semi-diurnal variation with maxima at 1 and 14 hours, and minima at 8 and 19 hours. It may be represented by the formula, $w = 545 + 0{\cdot}7 \sin 15h - 8{\cdot}5 \cos 15h + 12{\cdot}0 \sin 30h + 10{\cdot}9 \cos 30h - 4{\cdot}9 \sin 45h - 2{\cdot}0 \cos 45h\ (-1{\cdot}3 \sin 60h + 1{\cdot}0 \cos 60h)$, where w is in cm. per sec. and h indicates the hours from 0 (midnight) to 23. Tables are given for the monthly frequency of winds from each of 16 directions, the greatest frequency being from west. The average velocity and "travel" from each of these 16 directions is also given. A comparison of hourly wind velocities with estimates on the Beaufort scale (0–12) leads to the formula $W = 1{\cdot}4 + 1{\cdot}8B$, W being measured in metres per sec. R. G. K. L.

19. *Some Temperature Inversions in Colorado.* **F. Ramaley.** (Science, 28. pp. 695–696, Nov. 13, 1908.)—The campus of the University of Colorado is at an altitude of 5,420 ft.; another station on a mesa (flat-topped hill), ¾ mile to the south, is at an elevation of 5,835 ft. Yet the nights are less cold on the mesa. In May, 1908, the mesa mean temperature was 2·6° F. higher than the campus, the mean minimum even 3·4° F. higher, and the daily range smaller. Thus the mesa, which forms part of the lower foot-hills, has a milder climate than the campus, which is on the plains, in general agreement with Hann's rule that, in calm weather, the valleys are colder than the surrounding mountains up to a certain height. The importance of this feature for the distribution of plants is being investigated by G. S. Dodds and W. W. Robbins. H. B.

20. *A Calm Atmospheric Stratum, 3,000 or 4,000 ft. above Sea-level near Calcutta.* **C. Little.** (Asiatic Soc. of Bengal, Proc., Feb., 1908. Meteorolog. Zeitschr. 25. p. 427, Sept., 1908. Abstract.)—Pilot balloons, charged with coal gas or hydrogen, are watched, the elevation and azimuth and apparent diam. being determined every 2 min. Maximum heights of about 10,000 ft. were attained. Up to 4,000 ft. the wind is quite different, during the cold season, from the wind in the higher strata, and in the layer between the two strata very little movement is observed. H. B.

21. *Studies in Cloud Forms.* **A. de Quervain.** (Meteorolog. Zeitschr. 25. pp. 433–453, Oct., 1908.)—The author deduces a number of general principles from a series of continuous observations of clouds. His main results are: (1) The development of cumulostratus (stratocumulus of the international classification) from cumulus is an important factor in the formation of altocumuli. (2) Altostratus frequently consists of a double layer; suggested name *altostratus duplicatus.* (3) Certain "caps" frequently seen above or around large cumuli belong to the altocumulus level, and have no connection with thunder cirri. A sharp distinction should be drawn between these caps and the so-called false cirri, developed from cumulonimbus cloud. To the latter the adjective "false" is incorrectly applied, as the clouds are true ice clouds, as is shown by the formation of halos. (4) The development of *altocumulus castellatus* is evidence of the existence of a region of steep temperature gradient in the middle regions of the atmosphere, a view which is supported by balloon observations. This cloud form has great value as an indication of approaching thunderstorms. (5) Most true cirrus clouds (in summer in central Europe) are derived from cumulonimbus-like clouds which may have been formed at a great distance from the place of observation. R. G. K. L.

22. *Rainfall and Sea Temperature on the Togo Coast.* (Meteorolog. Zeitschr. 25. pp. 463–465, Oct., 1908. From Mitteil. aus den Deutschen Schutzgebieten, 1908.)—Rainfall observations at 21 stations for the year 1907 show a marked excess of fall at the coast stations compared with the long-period averages. The inland stations show a deficit. A comparison of the rainfall results for 1906 and 1907, with observations of sea temperature at Lome, brings out a distinct connection between the two, low water-temperatures being associated with low rainfall at coast stations, and *vice versâ* in the majority of months. R. G. K. L.

23. *Weather Elements of Bangalore,* 1895–1906. **J. Cook.** (Mysore Meteorol. Mem. No. 2, 1908. Extract by **J. Hann** in Meteorolog. Zeitschr. 25. pp. 472–478, Oct., 1908.)—Bangalore has a meteorological observatory of the first order, situated at 920 m. in latitude of about 13° N. Hourly records are taken. Temperatures are recorded by instruments in three positions, which sometimes differ by several degrees. Hann converts and analyses the tables. Feb. and March have 88 per cent. of sunshine, July only 34 per cent. H. B.

24. *Climate of Abbassia near Cairo.* **J. Hann.** (Meteorolog. Zeitschr. 25. pp. 458–460, Oct., 1908.)—The author extracts B. F. E. Keeling's "Climate of Abbassia," published 1907, as well as older reports (1869 to 1898) from Abbassia and Heluan and the reports of Austrian observers. Keeling calculates the sensible temperature from temperature and relative humidity.

The latter is not so very low on average, 46 per cent. in May and June, but may be exceedingly low. Rain comes rarely, chiefly during the winter, with the fringes of Mediterranean storms or with thunderstorms. The mean annual rainfall of the 17 years ending 1908 was 30·6 mm., ranging from 6·8 to 54·4 mm.; 25 mm. fell on July 25, 1900. H. B.

25. *Heat Conductivity of Snow.* **T. Okada, K. Abe, and J. Yamada.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 19. pp. 385–389, Sept., 1908.)—After brief reference to results of other workers, the authors give an account of 8 sets of hourly observations of the temperature of snow at depths of 5, 15, 25, and 35 cm. From these they deduce, by the Fourier-Poisson theory of the linear flow of heat, the conductivity and diffusivity of snow. The effect of density is small, as the range of densities worked with was small. The results are summarised in the formula $D = 0{\cdot}0039 + 0{\cdot}00021t$, where D is the diffusivity, t the temperature in centigrade degrees. R. G. K. L.

26. *Apparent Seasonal Variations of Sea-level.* **H. Nagaoka.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 19. pp. 382–385, Sept., 1908.)—In comparisons of sea-level elevations, the sea-level of reference is not the level surface at the same temperature and air pressure, but that of mean temperature and pressure. The effect of atmospheric pressure is not merely statical. The temperature variations are very large in shallow inland seas and on the Pacific coast of Japan, and little is known about the temperature gradient with increase of depth. At Chôshi the maximum fluctuation of the sea-level may amount to more than 20 cm., and the variation of sea-level generally seems to follow that of surface temperature. The author discusses these features on general lines without giving figures, and points out that these fluctuations seem to be connected with Kimura's small annual term in the latitude variation. During the different seasons the elevation and depression of the sea-level would be opposite in the northern and southern hemispheres. H. B.

27. *Imperfections in the Theory of the Equilibrium of the Earth's Crust.* **F. R. Helmert.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 44. pp. 1058–1068, 1908.)—Many observations of the force of gravity, and its deviation from the normal have been made in different regions of the earth's surface since 1884, when the present writer published a memoir on the subject in the Berichte of the Prussian Academy. Nevertheless, his determination of the constant in that term of Clairaut's formula which is proportional to the square of the sine of the latitude remains, he says, in substantial agreement with the results of later observations and with the works of Wiechert and G. Darwin. The differences in the calculated results of the observations were due to the disturbances of masses in the outer layers of the earth, although the effect of such was minimised by the introduction of the condensation method of calculation. He explains how the 1884 calculations were based on conditions approaching nearly to those of a uniform earth crust of 40 km. thickness. Then in 1901 followed observations, taken at the edges of continents, and others in mid continents, from which was deduced a difference in the force for the two regions respectively. Such difference had been first recognised by the writer in 1884. Further observations were necessary of the force in mid-ocean, to which end the writer made two voyages, to Rio in 1901, and to the Indian Ocean, Red Sea, and Mediterranean in 1904–5. According to these and other observations, the force of gravity at sea and far from land deviates little from the normal. That it is also nearly constant over all hitherto explored portions of the earth's surface justifies the doctrine of the "isostasy," or equilibrium state, of the concentric shells forming the earth's crust, the deviations being of a local or regional character. This leads to the conception of, underneath the actual surface, a level surface (Niveaufläche) of equal pressure. This is in effect Pratt's hypothesis, which, according to the author, is in the main justified. The author then discusses the actual observed deviations of gravity from the normal in certain localities. On the sea-level we have $\Delta g = g_0 - \gamma_0$, in which g_0 is the observed value, and γ_0 the normal value. In the reports of the Central Office of International Geodesy for 1900, 1903, and 1906 the quantity 0·0003086H is to be applied, not to the normal, but to the observed force, with reversed sign. This corresponds to the reduction of the observed value to the sea-level. The author considers that the disturbance of the ocean surface due to the condensation of external masses may be neglected, but the masses themselves exert a perceptible influence. Assuming the height of the geoid to be increased by N, he gives the formula $\frac{g_0'' - \gamma_0}{\gamma_0} = \frac{3}{2}\left(\frac{\theta D}{\theta_m R} - \frac{N}{R}\right)$, in which θD is the surface density of an ideal layer of rock corresponding to the internal masses which produce the disturbance at the sea-level, R is the earth's radius, and θ_m the earth's mean density, 5·52. Assuming as usual $\theta = 2{\cdot}4$, he gets $D = 10^6 \Delta g_0'' + 2{\cdot}3N$. According to the observations, N can rarely be as great as 100 metres. He discusses separately the case of small islands in mid-ocean. Referring to his treatise of 1884, he attributes the apparently high values of g in such islands, as compared with continents, to a concentration of masses at a depth of 21 km. For islands of very small area, the slope, or talus, has great influence. Examples are given of two of the Sandwich Islands. Later the author discusses modern observations in the Himalayas, Turkestan, Tibet, and other regions of Central Asia. It is remarkable that the deviation from the normal in these regions is to a great extent negative, which is not to be explained in accordance with Pratt's hypotheses. On the other hand, over a region extending from the British Isles to the Ural, a belt of 4,000 km. by 1,000 km. wide, the deviation is positive. In Sweden and neighbouring lands to the north of that belt it is negative. S. H. B.

28. *High Gaseous Velocities on Solar Surface.* **A. Schuster.** (Nature, 78. pp. 662–663, Oct. 29, 1908.)—Observations by Hale and others indicate the existence of gaseous masses on the solar surface moving with velocities up to 200 times the velocity of sound in hydrogen at the temperature of freezing water. It is suggested that, taking the absolute temperature of the sun as forty times that of freezing water, the observed velocities would become consistent with modern ideas of pressure motion only if the density of the gas were a thousand times less than that of hydrogen. This is very near the computed mass of the negative electron, and it is supposed therefore that the prominences and other features in which velocities of more than 10 km. per sec. are observed are composed to a preponderating extent of electrons in which gases are entangled to a sufficient degree to give the spectroscopic test, but not sufficiently to alter materially the average density. C. P. B.

29. *Eruptive Prominences on the Solar Disc.* **P. Fox.** (Astrophys. Journ. 28. pp. 253–258, Nov., 1908.)—In the course of routine spectroheliograph work especially brilliant points of the flocculi in the neighbourhood of sun-spots have been noted both in calcium and hydrogen photographs. Further observations of the spectra of these features show the existence of strong reversals and distortion, all indicating that they are the bases of eruptive prominences seen in projection on the disc. These eruptions are usually near the outer boundary of the penumbra of the spot. If the spot is actively growing, eruptions are often found on the following edge; in the case of complex spots, the eruptions generally occur between the leader and the following main spot. From the study of many such cases it is probable that the spot has its genesis in the prominence eruption. Several photographs are reproduced illustrating the relation of these phenomena, and incidentally also showing very clearly the vortices in spot areas, different in direction in the two hemispheres. C. P. B.

30. *Magnetic Field in Sun-spots.* **G. E. Hale.** (Astrophys. Journ. 28. pp. 315–343, Nov., 1908. Contribution from the Mount Wilson Solar Observatory, No. 30.)—The discovery of vortices surrounding sun-spots was first made possible by the special spectroheliograms taken in hydrogen (H_α) light [see Abstract No. 1586 (1908)]. These were discussed in connection with the known Zeeman-effect, and evidence was adduced to support the inference that the appearances photographed were really whirls of electrically charged particles [Abstract No. 1587 (1908)]. The present paper is on the same lines, but much more exhaustive, giving further evidence obtained from a great number of spectra recently obtained. An attempt was made to photograph the triplets into which the spectrum lines should be resolved when observed near the edge of the sun, the radiation then reaching us at right angles to the magnetic field. Tables are given comparing the separations of various lines in spark spectra and in laboratory spark spectra with different field strengths, from which it is seen that in the case of iron the agreement is so close that it can hardly be the result of chance. From the iron lines the spot field appeared to be about 2,690 gauss. The question as to the field varying in strength radially is discussed, and this view receives support from the relative behaviour of the arc- and enhanced-lines of iron; further work is necessary before the point can be decided. C. P. B.

31. *Upper Layer of Solar Atmosphere.* **H. Deslandres.** (Comptes Rendus, 147. pp. 1016–1023, Nov. 30, 1908.)—During the past year the observers at Meudon have succeeded in registering the complete area of the upper layer of the sun's atmosphere. Previous attempts have been unsuccessful owing to the difficulty of excluding radiations emitted by lower layers which are of greater brilliancy. By means of a special type of spectroheliograph, having three slits and great dispersion, the fine central ray K_3 has been isolated from K_2, and the discs thus obtained give details of the structure of the outermost layers of least density. During the latter part of the autumn good weather has enabled the author to obtain a good series of images extending over four rotations of the sun, so that most interesting comparisons may be made of the life history of the various features. Very remarkable features appear on the plates, chief of which are sharply defined long filaments, which seem to be situated along *alignments* for considerable periods. The author significantly suggests that these markings may have some analogy to the fine *canali* which have caused so much discussion on the planet Mars. [See Abstracts Nos. 1884, 1585 (1908).] C. P. B.

83. *The Planetary Rotation Problem.* **C. V. L. Charlier.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 27. pp. 1–14, 1908.)—The problem here mathematically treated is that of the rotation of a planet moving in a fixed plane about the sun, and disturbed in its rotational motion by the sun's attraction. It is assumed that the planet's orbit is a circle, and that two of its principal moments of inertia are equal. The calculations lead to the deductions: (1) The earth's rotation period, so far as the sun's influence is concerned, must always lie between the values 23h. 56m. and 24h. 4m. sidereal time. (2) The angle θ_0 between the central axis and the z-axis fixed in the earth can never exceed 4°·2. (3) The obliquity ϵ of the ecliptic, however, can have any value between −90° and +90°. In the subsequent work, the angle θ_0 between the central axis and the axis of figure is taken as zero. A formula is finally arrived at containing the principal terms of the disturbance. For the earth the formula becomes $\psi = \psi_0 + 15''\cdot94t - 1''\cdot268 \sin 2\lambda$, ψ_0 being a constant, t the time in tropical years, and λ the sun's longitude from the planet. For the other large planets calculation of the numerical coefficients of t and $\sin 2\lambda$ gives the following values: Mars 6″·321, 0″·946; Jupiter 0″·993, 1″·051; Saturn 0″·227, 0″·581. In the case of Uranus and Neptune the values of the ellipticity and time of rotation are too imperfectly known to allow of a conclusion as to the motion of the equatorial planes. As regards ϵ, the obliquity, it will be shown in a later paper that the equatorial planes of Uranus and Neptune very probably coincide with the orbital planes of their satellites. A. E.

83. *Changes in Comet Morehouse,* 1908c. **E. E. Barnard.** (Astrophys. Journ. 28. pp. 292–299, Nov., 1908.)—During its apparition in the northern hemisphere this comet exhibited most remarkable activity, changing in form every hour. Owing to its high northern declination exposures could be made throughout the night at intervals of a few hours, so that a complete history of the various phases has been obtained. The general tendency of the comet has been to produce a tail by a steady outflow of various streams of matter, but on several occasions great masses were thrown off which could be followed outward from the comet for several days before they were finally dissipated into space. The changes on Sept. 30, Oct. 1, and Oct. 15 are specially interesting, and the two former are illustrated in the article. Attention is drawn to the importance of obtaining photographs at short intervals during the whole period of visibility of comets showing traces of activity, so that the intermediate changes may be thoroughly investigated. **Baldet** and **F. Quénisset.** (Comptes Rendus, 147. pp. 1033–1036, Nov. 30, 1908.)—From Sept. 17–Nov. 6, 1908, 96 photographs of the comet have been obtained at the Juvisy Observatory, with six cameras of different focus and intensity. Two photographs are reproduced, illustrating the remarkable changes that occurred on Oct. 15 and 16, 1908. **F. Quénisset.** (Soc. Astronom. de France, Bull. Nov., 1908. Nature, 79. p. 80. Nov. 19, 1908. Abstract.)—Description of photographs of comet taken during Sept. and Oct., showing rapid changes of form. **H. Deslandres** and **J. Bosler.** (Comptes Rendus, 147. pp. 951–954, Nov. 23, 1908.)—Photographs of the spectrum of this comet have been obtained at the Meudon Observatory with both prismatic camera and slit spectrograph [see above]. The present paper gives the results obtained from an examination of the slit spectrograms. It was found that the radiations given by the tail show different inclinations, in some cases as much as 8°. Other peculiarities suggest that part of the cometary matter is rotating. [See also Abstract No. 1914 (1908).] C. P. B.

34. *Accuracy of Radial Velocity Determinations.* **J. S. Plaskett.** (Astrophys. Journ. 28. pp. 259–265, Nov., 1908.)—Previous investigations have shown that the exposure-time required for stellar spectra under average atmospheric conditions is almost inversely proportional to the slit-width until this reaches at least 0·075 mm. [Abstract No. 902 (1908)]. In applying this to determinations of radial velocity, there are three ways in which an increase of slit-width may lead to loss of accuracy: (*a*) By the decrease in purity and consequent difficulty of identification of lines and determination of the blended wave-lengths; (*b*) by increased diffuseness and breadth of the spectral lines and consequent probable increase of errors of measurement; (*c*) by systematic displacements of the lines as a whole with resulting error in the velocity, due to asymmetric position of the star image within the slit-opening. Experimental spectrograms of β Orionis with various slit-widths and three degrees of dispersion were made, and the results show that with proper dispersion a considerable slit-width may be used without seriously affecting the determinations of wave-length. C. P. B.

35. *Spectroscopic Binary ψ Orionis.* **J. S. Plaskett.** (Astrophys. Journ. 28. pp. 266–273, Nov., 1908.)—This star was first announced as a spectroscopic binary by Frost and Adams in 1903 [Abstract No. 485 (1904)], and has been under observation at Ottawa since Nov., 1907, forty spectrograms having been secured with the single-prism instrument (linear dispersion at $H_\gamma = 30{\cdot}2$ tenth-metres per mm.). The star is of the Helium type with very broad, diffuse lines, rendering the measurements difficult, so that the probable error is about ± 6·8 km., but as the lines are in general symmetrical it is easier than the star ι Orionis [Abstract No. 1078 (1908)]. A period of 2·52588 days is determined, and the large range of velocity, amounting to 288 km., is the highest known for this type of binary. C. P. B.

36. *Unusual Meteoric Fall.* **Elihu Thomson.** (Science, 28. pp. 516–517, Oct. 16, 1908.)—There was a remarkable fall of meteoric masses on Sept. 17, 1908, in the vicinity of Swampscott, Mass., U.S.A., at about a quarter past seven in the evening. A large part of the meteor is reported to have fallen into Boston Harbour. To the writer it appeared as a brilliant body descending rapidly and almost vertically from overhead. The light appeared of a pure greenish-blue, and gave the impression of actual combustion in addition to incandescence due to air friction. C. P. B.

REFERENCES.

37. *Mercurial Barograph of High Precision.* **C. F. Marvin.** (Monthly Weather Rev. 36. pp. 307–318, Sept., 1908.)—Describes the construction and use of the author's mechanically recording compensated siphon barograph.

38. *Deformation and Strength of Flat Plates.* **C. Bach.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1781–1789, Nov. 7, and pp. 1876–1881, Nov. 21, 1908.)—Gives detailed results of tests of two square and two rectangular flat plates under fluid pressure with measurements of deflections. As these are not generalised they do not admit of useful abbreviation. F. R.

39. *Dynamics of Rolling of a Ship.* **G. Greenhill.** (Engineer, 106. p. 609, Dec. 11, 1908.)

40. *Resistance of Fluids: Experiments necessary.* **M. Brillouin.** (Comptes Rendus, 147. pp. 918–920, Nov. 16, 1908.)—The author points out the directions in which further experiments are wanted regarding the movements of planes through fluids. C. A. B.

41. *Meteorology of Rikitea, Island of Manga Reva, Low Islands.* (Meteorolog. Zeitschr. 25. pp. 471–472, Oct., 1908. Extract by **J. Hann** from the Annales du Bureau Central Méteorol., 1908, and the Annuaire of the French Meteorol. Soc., based on the observations of L. Seurat and C. Dufour.)—The island belongs to the Gambier Archipelago. The diurnal variation of the barometer is particularly interesting. H. B.

42. *Analysis of the Atmospheric Gases which are not Liquefiable in Liquid Air.* **F. Bordas** and **Touplain.** (Comptes Rendus, 147. pp. 591–594, Oct. 5, 1908.)—A spectroscopic analysis of the lowest-boiling constituents of the atmosphere. E. C. C. B.

43. *Determination of Latitude and Time.* **P. Stoenesco-Dunare.** (Annal. Scientifiques de l'Univ. de Jassy, 5. pp. 66–79, 1908.)—Development of survey method for determination of position by observations of stars at equal altitudes. C. P. B.

44. *Variation of Latitude.* **W. Ebert.** (Journ. de Physique, 7. pp. 773–786, Oct., 1908.)—General discussion of the dynamical theory of terrestrial latitude variation, with illustrations of the curves showing results for the two periods (1890·0—1899·8) and (1899·9—1905·0). C. P. B.

45. *Determinations of Latitude made in Sakhalin.* **K. Hirayama.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 16. pp. 329–336, May, 1908.)—An account of the determinations made by the members of the Russo-Japanese Boundary Commissions in 1906 and 1907.

46. *Electrical Registration of Seismometric Observations.* **B. Galitzin. [Golicyn].** (Acad. Sci. St. Pétersbourg, Bull. 16. pp. 1223–1233, Nov. 15, 1908.)—By the measurement of the induced currents produced by the motion of a small freely suspended permanent magnet with a delicate galvanometer a method is being devised for the registration of small seismometer movements. [Compare Abstract No. 903 (1908).] C. P. B.

47. *The Infinite Universe.* **C. V. L. Charlier.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 24. pp. 1–15, 1908.)—Analysis of the supposed relations between the different types of bodies in the universe with regard to their distribution in space. C. P. B.

48. *Refraction of Jupiter's Atmosphere.* **Chevalier.** (Astronom. Nachr., No. 4272. Nature, 79. p. 143, Dec. 3, 1908. Abstract.)—Observations of a star occulted by Jupiter, showing deflection of star's apparent path when near the planet. C. P. B.

49. *Rotation of Mercury and Venus.* **C. V. L. Charlier.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 23. pp. 1–19, 1908.)—Analytical discussion of rotation periods from gravitational point of view. C. P. B.

50. *Motion of Minor Planets.* **F. J. Linders.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 20. pp. 1–29, 1908.)—Investigation of the stability of the motion of the asteroids under solar and planetary attraction. C. P. B.

LIGHT.

51. *Device to Aid in Explanation of Interference Phenomena.* **F. E. Wright.** (Amer. Journ. Sci. 26. p. 536, Dec., 1908.)—A brass rod is divided into three parts which can revolve separately about the common axis, and thin transparent celluloid plates are inserted into longitudinal slits in each section to represent the planes of vibration of light-waves at the various stages of their course through polariser, specimen, and analyser. G. E. A.

52. *Optical Dispersion Formulæ.* **R. C. Maclaurin.** (Roy. Soc., Proc. Ser. A. 81. pp. 367–377, Nov. 9, 1908.)—In the half-century that elapsed from the time when Cauchy published his memoirs on dispersion, the only measurements of refractive indices that were available for the test of any theory were confined to the neighbourhood of the visible spectrum. They extended from somewhat beyond $0{\cdot}2\,\mu$ to about $0{\cdot}8\,\mu$, *i.e.*, over a range of two octaves. In this range the variation of refractive index for most substances is small, and it is not surprising that, by a proper adjustment of constants, a variety of different formulæ may be made to fit the experimental facts. More recently, however, the range of observations has been immensely extended, so that we now have a large number of determinations of refractive indices for various wave-lengths extending from less than $0{\cdot}2\,\mu$ to $22{\cdot}3\,\mu$. With a knowledge extending over this range of about seven octaves, there is more hope of testing the merits of different dispersion formulæ. Accordingly, when, in 1879, Mouton made the first considerable extension in the direction of great wave-lengths, he found that, with the same number of constants, the formula of Briot represented the facts much better than did the older one of Cauchy, and the same result was reached by Langley in 1884 and 1886. The still more extended observations of Paschen, Rubens, E. F. Nichols, and A. Trowbridge, from 1892 to 1897, have shown that Sellmeier's formula—

$$n^2 = K + c_1/(\lambda^2 - \lambda_1^2) + \dots$$

is the only one of those that have been tried that is in thorough accord with the observed values of the refractive indices over the whole range of the experiments. But the author feels that there are various doubts and difficulties connected with the development of this formula from a sound dynamical basis in any of the various forms of its presentation, whether we follow directly the arguments of Sellmeier, Ketteler, Helmholtz or Kelvin, or express their ideas in the language of electron theory as Drude and others have done. Apart, however, from difficulties as to the exact character of the relation between ether and matter, and doubts as to the validity of certain dynamical principles employed in its evolution, the Sellmeier formula is open to two serious objections: (1) When the wave-length is indefinitely increased, the formula gives $n^2 = K$, so that, on the electromagnetic theory of light, K should be the dielectric constant of the medium. The values of K, determined by the Sellmeier formula from the observations of refractive indices by Rubens and Nichols, are 6·09, 4·58, 5·18, and 4·55 for fluorite, quartz, rock salt, and sylvin respectively, and the slightly different observations of the other physicists mentioned above make scarcely any appreciable change in the estimate of K.

There is not so good an agreement amongst different direct determinations of the dielectric constant. As the means of various such experiments the author finds respectively 6·8, 4·68, 5·98, and 4·94 for the four substances in question, the differences from the optically derived values being all in the same direction. (2) A more serious discrepancy reveals itself on comparing the calculated values of λ_2 and the observed positions of the absorption bands of different substances. According to theory, the absorption band should be found very near to λ_2, though not coincident with it. The values of λ_2, calculated from the formula to fit in with the experimental determinations of refractive indices by Nichols, Rubens, and Paschen for rock salt, sylvin, and fluorite are 56·12, 67·21, and 35·47 respectively, whereas the absorption bands were found at 51·2, 61·1, and 23·7. Here, again, the differences are all in the same direction, but of an order quite beyond the limits of experimental error. It must be noted also that the formula involves the *square* of λ_2, so that the observed and computed values are still more discrepant. After carefully considering the various ways of escape from these discrepancies, the author develops a theory which leads to the formula—

$$\frac{n^2-1}{n^2+a}=\frac{K-1}{K+a}+\frac{c_1}{\lambda^2-\lambda_1^2}+\frac{c_2}{\lambda^2-\lambda_2^2}+\dots+\frac{c_n}{\lambda^2-\lambda_n^2}.$$

Then, taking Langley's experimental results for rock salt, the problem is to determine the six constants, K, a, λ_1^2, λ_2^2, c_1, and c_2, from the formula above, stopping at the third term on the right side. The process of trial and error led to the following values :—

$\lambda_1^2 = 0·0160074$ $\qquad \lambda_2^2 = 2682·14$
$c_1 = 0·00191605$ $\qquad c_2 = 688·816$
$a = 5·51$ $\qquad K = 5·9$
$\lambda_1 = 0·12652$ $\qquad \lambda_2 = 51·8$

Calculating the refractive indices from the formula with these constants, the author finds a striking agreement between theory and experiment, the figures being usually the same to the fifth significant figure in seventy observations extending over nearly six octaves. The formula in question also agrees with experiment in indicating absorption bands in the neighbourhood of 0·12μ and of 51·8μ, and in suggesting a dielectric constant of 5·9 which is about the mean of the best determinations. For fluorite, using Paschen's values of n from $\lambda = 0·1856$ to $\lambda = 9·4291$, a similarly close agreement is found, the constants being—

$\lambda_1^2 = 0·00716764$ $\qquad \lambda_2^2 = 576·858$
$a = 1·04$ $\qquad K = 6·8$
$c_1 = 0·001808$ $\qquad c_2 = 231·856$
$\lambda_1 = 0·0846618$ $\qquad \lambda_2 = 24·0074$

Here, again, the value assigned to the dielectric constant is the mean of the best direct determinations, and the prediction as to positions of absorption bands is as near as could be desired. E. H. B.

53. *Anomalous Dispersion of Luminous Hydrogen.* **R. Ladenburg** and **S. Loria.** (Nature, 79. p. 7, Nov. 5, 1908. Phys. Zeitschr. 9. pp. 875–878, Dec. 1, 1908. Deutsch. Phys. Gesell., Verh. 10. 21. pp. 858–866, Nov. 15, 1908.)—A continuous spectrum, given by a narrow capillary tube filled with hydrogen at nearly atmospheric pressure and traversed by a convenient current from a large induction coil was employed. In that spectrum horizontal interference fringes were generated by using a Jamin interferential refractor, and one of the two rays was sent between the Jamin mirrors through a Geissler tube filled with hydrogen at about 4 mm. pressure. When this tube was put in series with the capillary tube, the interference fringes at both sides close to the red hydrogen line (H_α) suddenly changed their direction, showing directly the anomalous course of the refractive index near the "absorption line." By measuring the max. variation of the refractive index (8×10^{-7}) and the breadth of the H_α line (2–8 Å.U.), the authors found, according to the Drude-Voigt theory of dispersion, that the ratio of the number of "electrons of dispersion" to that of molecules of hydrogen is only about 1 to 50,000, and that the damping-constant, measured in wave-lengths, is of the order 2–8 Å.U. Anomalous dispersion at the other hydrogen lines, which is expected to be much smaller than that at the H_α line, on account of the smaller absorption, was not detected. The authors conclude that their experiments show that it is not possible to explain the dispersion of luminous hydrogen by the existence of one class of electrons only, as in the case of non-luminous hydrogen; it is necessary to introduce new "electrons of dispersion," and the frequencies of these seem to be those of the lines of the so-called first series of hydrogen. [See also Abstract No. 774 (1908).] A. W.

54. *Ultramicroscopic Investigations.* **J. Reissig.** (Ann. d. Physik, 27. 1. pp. 186–212, Sept. 25, 1908.)—In connection with the work of Siedentopf and Zsigmondy on the size of ultramicroscopic particles a series of investigations has been made on colloidal solutions of brown tellurium, selenium, silver, and red and blue gold. The linear dimensions of the particles in these solutions are given as calculated from the number of particles found in a given volume. The number to be observed by the ultra-microscope is not proportional to the content of dissolved substance, as all the particles become visible only in dilute solutions; the number of visible particles is also proportional to the intensity of the light. The latter half of the paper deals with the more purely chemical properties of the solutions. G. E. A.

55. *Illumination due to Diffusing Surfaces.* **U. Bordoni.** (Atti dell' Assoc. Elettr. Ital. 12. pp. 265–290, March–April, 1908.)—After discussing the laws of irregular reflection due to Lambert, Ångström, and Lommel, the author chooses that of Lambert for calculating the illumination at points near to a plane surface of finite size, since the three laws lead to equally inaccurate results for large angles of incidence and reflection, and that of Lambert is the simplest of the three and leads to a fairly close approximation when limited to small angles. The illumination at a point due to a plane surface is calculated in various cases, in terms of the intensity of the incident illumination, the coefficient of diffusion of the surface, and the position and boundary of the surface, as given by various co-ordinates. The effect of repeated reflection by two or more surfaces is described, and tables for the coefficient for various values of the co-ordinates are given. S. G. S.

56. *Law of Series Spectra.* **W. Ritz.** (Astrophys. Journ. 28. pp. 237–248, Oct., 1908.)—A further communication on the author's new series formula. [See Abstract No. 1619 (1908)]. It is shown how from the known spectral series of an element may be derived new series which represent accurately, without the inclusion of any new constant, nearly all of the series and lines discovered recently by Lenard, Bergmann, Saunders, and others. The new principle of combination also finds application to other spectra, particularly to helium and the alkaline earths. Closer relationships to the atomic weight than have hitherto been known are also furnished. In a recent paper [Abstract No. 914 (1908)] Ritz has shown that there are systems of the simplest sort of which the energy is purely electromagnetic and which conform to Balmer's formula, the laws of series and the analogous Zeeman-effect, &c. The vibration $\nu = N\ (1/4 - 1/m^2)$ is produced by the magnetic field of $(m - 2)$ elementary magnets turned towards each other, which are identical among themselves: in addition to this magnetic series the electron is subject to only rigid combinations. Similar facts hold good for other spectra. Higher numbers of the order thus correspond in a certain degree with higher magnetic polymerisations, which constantly become less stable, so that the lines become broader with an increasing number of the order, and also become constantly weaker. Violent motions, such as occur in an electric spark, are also unfavourable to stability, whence the series in the spark cease at lower numbers of the order than in the arcs. The magnetic field in an atom may be regarded in all spectra as produced by two poles of opposite sign, which separately may occupy different positions in the atom. In the case of hydrogen, these points lie at equal distances on a straight line. In any combination formula each of the terms represents the influence of one pole, and the possible positions of the separate poles permit the most varied combinations of the poles in pairs. As to a certain minimum prescribed in the number of the order *m*—which occurs in the case of no known processes of vibration—this mode of representation only affirms that the magnet poles are held by the structure of the atom at a certain minimum distance from the electron vibrating within an atom, an idea which is quite plausible. A. W.

57. *Optical Centre of Gravity of the Light Source in Polarimetry.* **O. Schönrock.** (Zeitschr. Vereines Deutsch. Zucker-Industrie, 57. pp. 217–224, 1907.)—Bates stated that the optical centre of gravity is dependent upon the rotation-dispersion [see Abstract No. 808 (1904)]. This the author shows to be wrong; he proves that the optical centre of gravity is independent of the rotation dispersion of the substance which is being examined, whether this dispersion be regular or anomalous. E. C. C. B.

58. *Origin of Spectra.* **A. Eagle.** (Nature, 79. p. 68, Nov. 19, 1908.)—The author here discusses the work of Ladenburg and Loria [see Abstract No. 58 (1909)]. The observation of the anomalous dispersion of luminous hydrogen in the neighbourhood of the H_α line and the known absence of the phenomena in ordinary hydrogen show conclusively that the spectrum lines of a substance are not free periods of the atoms in their normal state, but only of those systems produced somehow by the agency which gives rise to the spectra. Ladenburg and Loria remark that the anomalous dispersion in the neighbourhood of the other lines of the hydrogen series is expected to be much smaller than that at the H_α line. Similar results for sodium have already been obtained by Wood for the principal series. Considering these results it seems probable that the different series of lines in a spectrum are produced by entirely different vibrating systems, while any system possibly only emits one line at a time of its own particular series, depending on the manner in which it has been struck. It is evident that the different vibrating systems obtained, and their relative proportions, may be expected to vary with the nature of the electrical discharge producing the spectra, and hence the variation of the spectra under different conditions. An extension of the work of Ladenburg and Loria is desirable, for by examining every line in the spectrum of an element we could, for instance, say whether a line was faint because very few systems were emitting it, or whether its faintness must be attributed to the fact that the vibrations producing this line have only a very small amplitude. [See Abstract No. 61 (1909).] A. W.

59. *Reduction of Prismatic Spectrum to Normal Scale.* **A. Fowler** and **A. Eagle.** (Astrophys. Journ. 28. pp. 284–291, Nov., 1908.)—This is a complete analytical determination of the conditions for producing a normal scale spectrum from a prismatic spectrum, in which latter the lines are crowded closer towards the red in terms of wave-lengths. To do this all that is found necessary is to incline the negative bearing the prismatic spectrum so that its less refrangible or red end is nearer the lens, and the enlarging board is inclined also at a suitable angle. The proper angles for any case are computed by a simple formula which is devised in the paper, and a worked example illustrates the degree of accuracy which may be expected. C. P. B.

60. *Electric Furnace Spectra of Titanium and Vanadium.* **A. S. King.** (Astrophys. Journ. 28. pp. 300–314, Nov., 1908. Contribution from the Mt. Wilson Solar Observatory.)—In continuation of a series of investigations on sun-spot spectra, an electric furnace has been specially built for the Solar Observatory at Mount Wilson, so that the more refractory elements could be vaporised without any other agent than heat. The furnace is of the *resistance-tube* pattern, of constant resistance, the various temperatures being regulated by variations of the terminal voltage. Tubes of Acheson graphite have, up to the present, given most satisfactory results. Current is used from a 50-kw. transformer with primary voltage of 2,000; giving either 5, 10, 20, or 30 volts to the furnace. Measurements of temperature were made with a Wanner pyrometer, ranging from 1,700° C. to 3,015° C. The spectra have been photographed with a Littrow spectrograph of 18 ft. focus, using the first order of a plane grating with 14,438 lines to the inch. Tables are given showing the lines present in the furnace spectra of Ti and V from λ4200–λ5500. C. P. B.

61. *Connection between Band and Line Spectra of the same Metallic Elements.* **W. N. Hartley.** (Roy. Dublin Soc., Trans. 9. pp. 85–138, Oct. 1, 1908.)—An exhaustive investigation into the production of band and line spectra in the flame. Both are proved to be due to the atoms in the cases of Pb, Sb, Bi, Sn, Zn, Cd, Cu, Ag, and Au. The first part of the paper is mainly concerned with quantitative relations. Ashless filter papers impregnated with definite quantities of solutions of the various salts were introduced into the flame and the spectra examined. The second part deals more with the connection between band and line spectra of the same element. The author points out that it is unquestionable that arc and spark lines are caused by the largely increased amount of energy over that available in the flame, and assuming that this excess is in part added to the atom it is conceivable that the components of the atom are thrown into a different mode of vibration. This view would lead one to expect that different groups of elements, according to their chemical properties, would acquire different quantities of energy, and individual elements belonging to the same group would show gradational differences in this respect. The evidence of this would be that different groups would exhibit line spectra with greater or less facility; and elements

of the same group under the influence of the same source of energy would differ in the number of lines in their spectra or in the proportion of lines to bands. This is exactly in accordance with observation in at least 40 out of 44 elements. In the paper the characteristic flame spectra have been tabulated, and the following facts are noted: The facility with which the alkali metals give line spectra and with which the alkaline earth metals yield band spectra with few lines. The elements in groups 3, 4, 5, and 6 of the periodic table exhibit scarcely any but continuous spectra in the flame, while the corresponding arc and spark spectra are very complex. Each of the sub-groups contains as a rule three elements which yield characteristic flame spectra with either lines or bands preponderating. The author therefore concludes that the metallic elements with monatomic molecules which exhibit both a line and band spectrum can exist in two different conditions, the difference being in the larger amount of energy associated with the atom giving a line spectrum. The acquisition of energy by the primitive or normal atom arises from its chemical properties and from the excess of energy transferred to it in the flame or arc, over that which is necessary to liberate the atom from its compounds. E. C. C. B.

62. *Series in the Spectrum of Barium.* **F. A. Saunders.** (Astrophys. Journ. 28. pp. 223–228, Oct., 1908.)—The author has photographed the Ba spectrum between λ = 8000 and λ = 1900, and has observed the first and second subordinate series of triplets. Certain lines are still missing, but they are very faint, and in certain cases they coincide with other strong lines. For the first series a formula of Ritz's type gives very good results—

$$1/\lambda = 28481 - \frac{109675}{(m + 0{\cdot}87045)^2 - 1{\cdot}655},$$

while for the second series the universal constant 109675 does not apply, and the only suitable equation is—

$$1/\lambda = 28062 - \frac{78892{\cdot}7}{(m + 0{\cdot}9027)^2 + 1{\cdot}1403}.$$

The spectra of Ca and Sr contain groups of narrow triplets, which form at least one series and probably two. These are present in Ba also, but the author considers the observations at present too incomplete to fit a formula to them. E. C. C. B.

63. *Spectrum of Scandium, and its Relation to Solar Spectra.* **A. Fowler.** (Roy. Soc., Phil. Trans. Ser. A. 209. pp. 47–70, Nov. 6, 1908. Roy. Soc., Proc. Ser. A. 81. pp. 335–336, Nov. 9, 1908. Abstract.)—A complete study of the arc and arc-flame spectra of Sc. The oxide was employed and fed into the arc between carbon poles, a small quantity of sodium or potassium silicate being added to increase the volatility. The arc-flame was produced by using large quantities of the silicates or of NaCl. There are two distinct sets of lines in the spectrum. One of these sets corresponds to the enhanced lines of other elements, although they strongly appear in the arc spectrum, but they are much weaker in the arc-flame. These lines occur as relatively strong Fraunhofer lines; they are weakened in the sun-spot spectrum and occur as high-level lines in the chromosphere. The second set of lines are relatively strong in the arc-flame and they are freely represented in the Fraunhofer spectrum; the stronger lines are prominent in sun-spot spectra, and they have not been

observed in the spectrum of the chromosphere. Tables are given of the wave-lengths of the lines and also of the flutings. These flutings are in all probability due to the oxide, as they do not appear when the arc is surrounded by an atmosphere of hydrogen. E. C. C. B.

64. *Emission Spectra of certain Elements at High Temperatures.* **E. Paternò and A. Mazzucchelli.** (Accad. Lincei, Atti, 17. pp. 428–432, Nov. 8, 1908.)—The authors have examined the emission spectra S, Se, Te, P, As, and Sb, when heated above their boiling-points in tubes of quartz, in the upper part of which a current of CO_2 is maintained. Sulphur gives a blue light and a continuous spectrum. Selenium yields a yellow vapour, which becomes reddish as the temperature rises, and at the point when the quartz softens is almost white; its spectrum is discontinuous, numerous bands being distinctly visible. The yellow vapour of tellurium becomes green with increase of temperature, and then bluish, and its spectrum shows more bands even than that of selenium. The results with phosphorus and arsenic are less distinct, the spectra obtained being very feeble, and no bands could be detected. At about 1,400° the emission spectrum of antimony is almost continuous, but shows brilliant bands. In the groups S, Se, Te, and P, As, Sb, band spectra and greater luminosity are more easily obtained with the elements of higher atomic weight. The phenomenon of variable dissociation is not sufficient *per se* to account for discontinuity, since S, P, and As, all polyatomic molecules, give continuous spectra. W. H. St.

65. *Spectral Analysis of Glow-light in Various Gases.* **F. Himstedt and H. v. Dechend.** (Phys. Zeitschr. 9. pp. 852–853, Dec. 1, 1908.)—Platinum points a few cm. apart were used for the discharge, which was maintained by an influence machine. The light was then analysed by a quartz spectrograph. The following gases were dealt with: O, Cl, N, H, HCl, CH_4, Air, NO, CO, and CO_2. O and Cl gave elementary line-spectra with strong continuous spectrum, N gave the first band spectrum. The compound gases all suffered decomposition. HCl showed chiefly the strong Cl lines, also the H lines and an underground of continuous spectrum. CH_4 gave H lines and the Swan spectrum. NO showed the first band spectrum of N. Air gave the same spectrum. CO gave lines and CO_2 bands. The paper is illustrated by photographs showing the spectra of CO_2, CO, H, and N. [See also Abstract No. 296 (1908).] E. H. B.

66. *Absorption Spectra of Vapours of Benzene and its Homologues, and of Solutions of Benzene.* **W. N. Hartley.** (Roy. Soc., Phil. Trans. Ser. A. 208. pp. 475–528, Oct. 26, 1908. Abstracts in Roy. Soc., Proc. Ser. A. 80. pp. 162–165, March 5, 1908. Chem. News, 97. pp. 97–98, Feb. 28, 1908.)—The author has made a most exhaustive study of the absorption spectra of the vapours of benzene, toluene, ethylbenzene, the three xylenes, and mesitylene. The source of light was the electric spark between Cd electrodes, and the vapour was enclosed in or conducted by an air current through a tube of bronze or glass provided with quartz ends. Full measurements and photographs are given in the paper, the observations being made at constant pressure with change of temperature, and *vice versâ.* E. C. C. B.

67. *Influence of Temperature and Magnetic Field upon Selective Absorption and Fluorescence Spectra.* **H. du Bois and G. J. Elias.** (Ann. d. Physik, 27. 2. pp. 288–300, Oct. 15, 1908. From the Bosscha Laboratory.)—An

exhaustive study of the influence of temperature and a powerful magnetic field upon the absorption and fluorescence spectra of a great number of substances belonging to the authors' first, third, fifth, and seventh paramagnetic series. They find in general that the Zeeman-effect is not independent of temperature and the nature of the anion. The Zeeman-effect is especially evidenced in the case of crystallised dilute solid solutions such as precious stones and certain rare minerals. The values of $d\lambda/\lambda^2$ vary considerably, but are of the order 10^{-1} cm. for fields of 40 kilogauss. Several double salts of Cr and K show at $-180°$ a broadening of the bands in strong fields. The red absorption bands of the ruby are split into triplets or quadruplets according to the orientation. The corresponding fluorescence bands behave in exactly the same manner. The salts of the rare earths, especially the nitrates, give the greatest number of typical Zeeman-effects. E. C. C. B.

68. *Contribution to the Knowledge of Luminescence.* **J. de Kowalski.** (Acad. Sci. Cracovie, Bull. No. 8. pp. 649–764, Oct., 1908.)—The author deals with the whole phenomenon of luminescence, and conceives of the existence, first, of an electronogenic system which is defined as a system of electrons of which one at least is very near the limits of stable dynamic equilibrium. The acceptance of a very small amount of kinetic energy will be sufficient to cause the limit electrons to fly out from the system. Secondly, he conceives of a luminophore which is a system of electrons in stable dynamic equilibrium with no electrons near the limit of stability. These two conceptions the author employs to explain various phenomena—for example, the luminescence under Röntgen rays, &c., would be due to the electronogens shooting off electrons, the energy of which is absorbed by surrounding luminophores with the result that luminescence is caused. E. C. C. B.

69. *Secondary γ-Radiation.* **J. P. V. Madsen.** (Roy. Soc. of South Australia, Trans. 32. [pp. 1–30], 1908; also Nature, 79. pp. 67–68, Nov. 19, 1908.)—Experiments by Bragg and the author upon the secondary radiation which proceeds from matter through which γ-rays are allowed to pass, taken in conjunction with a similar result obtained by Cooksey for Röntgen rays, support the theory of the material nature of Röntgen and of γ-rays originally advanced by Bragg. The modification of the ether-pulse theory recently advanced by Thomson may possibly furnish a partial explanation of these effects, but in the light of some experiments recently carried out by the author upon the secondary γ-rays, even this modification seems quite insufficient. A summary of the results of these experiments is given below. (1) The γ-rays of Ra, and probably of Th, appear to consist of two distinct homogeneous bundles, the value of λ/Δ (where λ is the absorption coefficient and Δ the density of the material) for the soft set being approximately four times that for the hard. (2) For each set of rays the value of λ/Δ is constant and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded. (3) Secondary γ-radiation appears on both sides of a plate which is penetrated by a stream of γ-rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides. (4) A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides. (5) The last results seem very difficult to reconcile with a pulse theory. On the "material" theory no such difficulty arises. (6) The secondary γ-radiation appears to be derived from the primary by a process of scattering, this process generally

involving a reduction in the subsequent penetrating power of the ray affected. (7) There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered, also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight. (8) The absorption of γ-radiation which has already passed through a thickness of one substance by screens of a different substance, may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens. [See also Abstract No. 1445 (1908).] A. W.

70. *Production of Helium from Uranium.* **F. Soddy.** (Nature, 79. p. 129, Dec. 3, 1908.)—Uranium nitrate was tested by the method previously described [Abstracts Nos. 1956, 1962 (1908)] to find whether any helium could be detected as produced from it. In one experiment 4 kg. of uranium nitrate containing 1,850 gm. of uranium were used. The first test for helium was made after a period of 61 days, and helium in several times the minimum quantity detectable by the method was proved to be present. By the second test, after a period of 27 days, helium was again shown to be present. The rate of production is about 2×10^{-12} (year)$^{-1}$. J. J. S.

71. *Influence of Temperature on Radio-active Transformations.* **H. W. Schmidt and P. Cermak.** (Phys. Zeitschr. 9. pp. 816–821, Nov. 15, 1908. Paper read before the 80. Naturforscherversamml. Köln. Deutsch. Phys. Gesell., Verh. 10. 20. pp. 675–687, Oct. 30, 1908.) Describes with diagrams, curves, and tables the elaborate tests made as to the action, if any, of temperature on the radio-active phenomena, from which the author concludes as follows: The certain result of the investigation is that no influence whatever directly due to temperature either on the radiation or the rate of transformation of the radium products, up to radium C, and temperatures up to 1,500° C., could be detected by the most sensitive instruments. [See also Abstracts Nos. 719 (1906), 649 (1907), and 1431 (1908).] E. H. B.

72. *Radio-activity of Potassium.* **N. Campbell.** (Cambridge Phil. Soc., Proc. 14. pp. 557–567, Nov. 20, 1908.)—A further investigation of the remarkable activity of the salts of potassium is described. This activity appears to be due to the emission of β-rays, and the question arises whether there is associated with potassium an active element closely resembling it in chemical properties, or whether the activity is due to potassium itself or to an element descended from it. The attempt was made, but without success, to separate from a potassium salt some part of its activity. All attempts to observe or to produce any difference in the activity of different samples of the same potassium compound in the same physical state failed completely. No evidence has been obtained of any such separation of the activity as is to be expected whatever view may be taken of the source of the activity. The activity of a thick layer of a potassium compound is not accurately proportional to the amount of potassium which it contains. It is probable that the variation from strict proportionality is to be attributed to a difference in different compounds, of the values of the ratio of the density of the substance to the absorption-coefficient of the rays emitted by it. In the case of solutions the variations in the value of this ratio are surprisingly large and irregular. The ratio is not necessarily greater for the solution of greater density or greater concentration. It was found that the activity of a solution was considerably less than that which would be predicted from the amount of potassium which it contained. J. J. S.

73. *Radium Emanation in Atmosphere.* **A. S. Eve.** (Phil. Mag. 16, pp. 622–632, Oct., 1908.)—In a previous paper [Abstract No. 417 (1908)] the author has given a preliminary account of determinations of the amount of radium emanation present in the atmosphere. The results are now given of experiments, continued at intervals throughout a year, which not only determine the amount with greater accuracy, but also throw some light on the effect of meteorological conditions in causing variations in that amount. The results obtained are summarised below: (1) The amount of radium which would be in equilibrium with the average amount of radium emanation present in 1 cub. m. of air, as measured at Montreal at intervals extending over a year, 1907–1908, is 60×10^{-12} gm. (2) The amount of radium emanation in the atmosphere varied so that the maximum is to the minimum as about 7 : 1. (3) The amounts in summer and in winter are not widely different, and large differences in temperature appear to have little or no direct influence on the quantity. (4) The approach of a deep cyclone, accompanied by heavy rain or a quick thaw of snow, causes an increase, whilst anticyclonic conditions, with dry or very cold weather, give a decrease of the radium emanation in the air. A. W.

74. *Radio-activity of the Gas from the Thermal Water of Uriage-les-Bains.* **G. Massol.** (Comptes Rendus, 147. pp. 844–846, Nov. 9, 1908.)—The gas evolved spontaneously in the siphon attached to the well contains 7 per cent. $CO_2 + H_2S$, and 93 per cent. nitrogen and its congeners, and its radio-activity, expressed in mgm.-minutes, is about 0·147, which is only about one-fourth of that of the gas dissolved in the water, the difference being due to the solubility of the emanation in water. The rock whence the water is obtained possesses no radio-activity, and the residue left by the water on evaporation is also inactive. [See next Abstract.] W. H. Si.

75. *Radio-activity of the Waters of Uriage-les-Bains.* **P. Besson.** (Comptes Rendus, 147. pp. 848–850, Nov. 9, 1908.)—Three litres of the sulphurous saline water were kept boiling for an hour, and the gases collected over mercury were dried and introduced into the measuring apparatus, the radio-activity being measured after an interval of 3 hours, the optimum period of Curie and Laborde. Expressing the results as equivalent to those produced by the emanation from *n* mgm. of radium per minute, the value found for *n* was 0·015, and it appeared to increase as the pressure diminished. It further decreases to one-half in four days according to Curie's law. G. E. A.

76. *Radio-active Deposit in Mid-ocean.* **A. S. Eve.** (Nature, 78. p. 604, Oct. 15, 1908.)—The deposit was collected on a wire, insulated by ebonite rods, suspended from the flag halyards of the ss. *Lake Erie,* and negatively charged by a Zamboni dry pile. After exposure it was coiled on a skeleton-reel and placed in an electroscope. The results obtained in mid-Atlantic appear to approximate to those found in Canada or in England, but the amount of active deposit determined at any given locality is liable to considerable variations. The experiments, as far as they go, indicate that the active deposit due to radium is prevalent to nearly the same extent over land and sea. Observers have also found that the ionisation of the atmosphere,

measured by Ebert's apparatus, is nearly the same over the ocean and over the land. Hence, in mid-ocean, the radium emanation, which decays to half-value in 8·8 days, and gives rise to the active deposit, cannot be entirely wind-borne from the land, but the emanation enters the air from the ocean somewhat as from the ground. This is contrary to expectation, for the average number of gm. of radium per c.cm. of rock is about $8{\cdot}5 \times 10^{-12}$ (Strutt) and per c.cm. of sea-water 8×10^{-14} (Joly). It is, however, probable that the emanation in solution in sea-water escapes more readily than the greater quantity generated in soil or rock. A. W.

77. *Development of Radio-activity in Volcanic Products from the Vesuvian Eruption of* 1906. **R. Nasini** and **M. G. Levi.** (Accad. Lincei, Atti, 17. pp. 485–487, Nov. 8, 1908.)—The authors have re-examined a number of samples of lava and scoria, which in 1906 possessed no radio-activity. Of six samples, four have now become radio-active, the saturation currents in amps. ranging from 8×10^{-15} to $15{\cdot}7 \times 10^{-15}$, which are of the same order as those of older Vesuvian products, confirming the authors' view that lava which is inactive immediately after solidification becomes radio-active after a lapse of time. [See also Abstract No. 65 (1907).] W. H. Sr.

REFERENCES.

78. *Simple Quartz Spectrograph.* **O. Reichenheim.** (Zeitschr. Instrumentenk. 28. pp. 340–342, Nov., 1908. Communication from the Physikal.-Techn. Reichsanstalt.)—Descriptive.

79. [*Michelson's*] "*Echelon*" *Spectroscope.* **B. Golicyn [Galitzin].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40 pp. 168–186 [Physical Part], 1908.)—The author gives the elementary theory of Michelson's echelon spectroscope and shows how it may be applied to: (1) the investigation of the structure of individual spectral lines; (2) the investigation of the expansion of spectral lines; (3) the splitting of certain lines; (4) the verification of Doppler's principle for light rays. T. H. P.

80. *Formation of Secondary Images by Lenses.* **G. Maltézos.** (Comptes Rendus, 147. pp. 736–738, Oct. 26, and pp. 850–852, Nov. 9, 1908.)—Expressions are obtained for the positions of the secondary images formed by a beam of light which suffers one or two reflections within a thin lens. These are applied in evaluating the approximate refractive index and the radii of curvature of the lens. In the second paper thick lenses are dealt with. The reciprocals of the distances of the secondary images are expressed as continuous fractions and an experimental verification of the expressions is given. G. E. A.

81. *Reflecting Power of Clouds.* **C. G. Abbott** and **F. E. Fowle, Jr.** (Monthly Weather Rev. 36. pp. 285–286, Sept., 1908.)—[See addendum referred to at end of Abstract No. 1380 (1908).]

82. *Luminescence Phenomena with Blue Fluor-spar.* **E. Meyer.** (Phys. Zeitschr. 9. pp. 810–816; Discussion, p. 816, Nov. 15, 1908. Paper read before the 80. Naturforscherversamml., Köln. Deutsch. Phys. Gesell., Verh. 10. 20. pp. 643–657, Oct. 30, 1908.)—This paper is illustrated by nine photographs showing the actinic effects of fluorite from Wölsendorf, in Bavaria, and from Säntis, in Switzerland. The photographic exposures range from 42 hours (in the case of a specimen illuminated by the arc light for 15 min. and then left in the dark for 80 min.) to 1,440 hours (for a specimen which had been 150 days in the dark). [See also Abstract No. 2092 (1901).] E. H. B.

HEAT.

83. *Boiling-point of Sulphur on the Constant-pressure Air Thermometer.* **N. Eumorfopoulos.** (Roy. Soc., Proc. Ser. A. 81. pp. 339–362, Nov. 9, 1908.)—Eleven measurements of the boiling-point of sulphur gave results varying from 443·47° to 443·84°, the mean being 443·62°, or, omitting one somewhat unreliable series of measurements, 443·58°. T. H. P.

84. *Boiling-point of Sulphur.* **H. L. Callendar.** (Roy. Soc., Proc. Ser. A. 81. pp. 363–366, Nov. 9, 1908.)—The author refers to the difficulties met with in using the air thermometer [compare Eumorfopoulos, see preceding Abstract]. One of the chief of these is a continual change which occurs in the volume of the bulb when the latter is of Jena glass. The value obtained for the boiling-point of sulphur depends on the expansion of mercury, which is not known with great accuracy. T. H. P.

85. *Relation of the Specific Heats, $c_p/c_v = k$, in Dry Air free from CO_2, as a Function of the Pressures at Temperatures 0° and −79·8° C.* **P. P. Koch.** (Kgl. Bayer. Akad. München, Abhandl. II. Kl. 23, Bd. 2, 1907. Ann. d. Physik, 27. 2. pp. 311–345, Oct. 15, 1908. Abstract.)—The author has determined the isotherms of dry air for 0° and −79° and for pressures from 1 to 20 atmos. the results being compared with those of Amagat (Ann. Chim. phys. 6, 29. p. 68, 1893) and Witkowski (Phil. Mag. 41. p. 288, 1896). The values of *pv* found are as follows :—

p (atmos.).	*pv* at 0°.	*pv* at −79·1°.
1	1·0000	0·7097
25	0·9821	0·6628
50	0·9782	0·6199
75	0·9682	0·5820
100	0·9656	0·5572
125	0·9685	0·5495
150	0·9672	0·5540
175	0·9875	0·5715
200	1·0016	0·5960

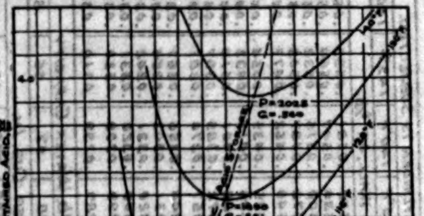
The mean coefficients of expansion of air between 0° and −79° are : 0·00411 ($p = 25$) ; 0·00459 ($p = 50$) ; 0·00504 ($p = 75$) ; 0·00585 ($p = 100$) ; 0·00547 ($p = 125$) ; 0·00547 ($p = 150$) ; 0·00533 ($p = 175$) ; 0·00512 ($p = 200$), the pressures in atmos. being given in brackets. The values of $c_p/c_v = k$ at 0° vary from 1·478 for 25 atmos. to 1·828 for 200 atmos. and at −79·8° rise from 1·405 for 1 atmo. to 2·469 for 150 atmos., and then fall to 2·333 for 200 atmos. From van der Waals' equation and for the relation $(\partial c_p/\partial p) = -\delta(\partial^2 v/\partial \delta^2)$ for all homogeneous bodies, it is deduced that the ratio c_p/c_v should at −79° reach its max. value at about 120 atmos. pressure, whilst at 0° the max. should be attained at a pressure higher than 200 atmos. ; these numbers agree well with the experimental values given above. T. H. P.

88. *Physical Properties and Conditions of Storage of Carbonic Acid.* **R. T. Stewart.** (Amer. Soc. Mech. Engin., Journ. 30. pp. 1361–1418, Nov., 1908.) —The average value of the weight of 1 litre of CO_2 at 0° C. and 760 mm. pressure, deduced from the results of Rayleigh and Leduc is 1·976 gm., the commonly accepted value being 1·965, probably deduced on chemical grounds. As the error in the calculation of the density of gases rapidly increases with critical temperature, direct determination is preferable. Amagat's data for the relation between temperature, vapour tension, density, and

RULE.—To find thickness of cylinder wall, multiply outside diam. by thickness factor corresponding to working stress and greatest storage temperature.

Max. Stress in Wall, lbs. per Sq. Inch.	GREATEST TEMPERATURE TO WHICH CHARGED CYLINDER IS SUBJECTED.											
	100°F	105°F	110°F	115°F	120°F	125°F	130°F	135°F	140°F	145°F	150°F	155°F
	FACTORS FOR THICKNESS OF CYLINDER WALL, OR t/D.											
15000	.0398	.0426	.0452	.0476	.0499	.0521	.0542	.0562	.0581	.0599	.0616	.0633
16000	.0375	.0401	.0425	.0449	.0470	.0491	.0511	.0530	.0547	.0564	.0581	.0597
17000	.0353	.0378	.0401	.0423	.0443	.0463	.0482	.0500	.0516	.0532	.0548	.0563
18000	.0334	.0357	.0379	.0400	.0419	.0438	.0455	.0472	.0487	.0503	.0518	.0533
19000	.0316	.0338	.0359	.0378	.0397	.0415	.0432	.0448	.0462	.0477	.0492	.0506
20000	.0300	.0321	.0341	.0359	.0377	.0394	.0410	.0425	.0439	.0454	.0468	.0481
21000	.0286	.0306	.0325	.0342	.0359	.0375	.0391	.0406	.0419	.0433	.0446	.0459
22000	.0273	.0292	.0310	.0327	.0344	.0359	.0374	.0388	.0401	.0414	.0427	.0439
23000	.0261	.0279	.0297	.0313	.0329	.0344	.0358	.0372	.0385	.0397	.0409	.0421
24000	.0251	.0268	.0286	.0300	.0316	.0330	.0344	.0357	.0370	.0381	.0393	.0405
25000	.0241	.0258	.0274	.0289	.0303	.0317	.0331	.0344	.0356	.0367	.0379	.0390
26000	.0232	.0248	.0264	.0278	.0292	.0306	.0319	.0331	.0343	.0354	.0365	.0376
27000	.0223	.0239	.0254	.0268	.0282	.0295	.0307	.0320	.0331	.0342	.0353	.0363
28000	.0215	.0231	.0245	.0259	.0272	.0285	.0297	.0309	.0320	.0331	.0341	.0351
29000	.0208	.0223	.0237	.0250	.0263	.0275	.0287	.0298	.0309	.0320	.0330	.0340
30000	.0202	.0216	.0229	.0242	.0254	.0266	.0278	.0289	.0299	.0310	.0320	.0329
These charging factors are substantially correct for stresses from 15,000 to 30,000 lbs. per sq. in.	MEAN DENSITY, OR lbs. OF CARBONIC ACID PER lb. WATER CAPACITY											
	.65	.64	.63	.62	.61	.60	.59	.58	.57	.56	.55	.54
	MEAN WEIGHT OF CARBONIC ACID IN lbs. PER CUB. IN.											
	.0235	.0232	.0228	.0224	.0220	.0216	.0212	.0208	.0205	.0201	.0198	.0195
	MEAN WEIGHT OF CARBONIC ACID IN lbs. PER U.S. GALLON											
	5.42	5.36	5.27	5.17	5.07	4.98	4.90	4.82	4.73	4.65	4.57	4.51

PV are given in revised form with adjustment of values to the smooth curves. Tables are then given of the pressure, density, volume, and temperature relations in commercial units from 0° to 31·35° C., and the fraction of cylinder volume occupied by liquid for different combined densities of liquid and saturated vapour is also tabulated. The results of experiments on commercial samples of CO_2 containing respectively 0·7 and 1·7 per cent. of air show that under the usual storage densities the presence of 1 per cent. of air corresponds to an increase of fluid pressure of about 60 lbs. per sq. in. To a first approximation the weight of a cylinder relative to its CO_2 content is a minimum when the pressure ÷ density (p/G) is a minimum. The curves relating p to p/G for various temperatures have sharply defined minima. It can readily be shown that $W/w = 81{\cdot}87t(D-t)/G(D-2t)^2$, where W is weight of cylinder in lbs. per ft. length, w is weight of CO_2 in lbs. per ft. length of cylinder, D is the external diam. of cylinder, in inches, and t the thickness of cylinder wall, in inches. Combining with this a closely approximate formula deduced by the author for the strength of cylinders of this class, viz., $D/t = 2{\cdot}325f/p$, where f is the stress, we get—



$$\frac{W}{w} = \frac{81{\cdot}87}{\left(2{\cdot}325\frac{f}{p} + 0{\cdot}43\frac{p}{f} - 3\right)G}.$$

From this formula the curves shown in the Fig. for a working stress of

15,000 lbs. per sq. in. are constructed, and the table gives in a collected form all the data necessary for design, provided the quality of material be known. F. R.

87. *Temperature Variation of Ratio of Specific Heats.* **R. Fürstenau.** (Ann. d. Physik, 27. 4. pp. 735–772, Nov. 26, 1908. From Inaug.-Dissertation, Giessen., 1908.)—The speed of sound in various gases at different temperatures is determined by use of a Quincke's interference tube fitted with a side tube at which an observer listens till the sound is reduced to a minimum by adjustment of the end stop in the main tube. The frequency being determined by control experiments, and the wave-length of the stationary waves being thus measured the speed of sound is calculated, whence γ, the ratio of the specific heats, the pressure and density of the gas being known. The chief results are as follows: (1) Between 0° and 500° C. the value of γ in air does not vary 1 per cent. (γ falls from 1·402 to 1·399). (2) For the same limits γ decreases with rising temperature by about 3·5 per cent. in CO_2 and 4·8 per cent. in SO_2. (3) Between 0° and 300° C. γ falls by about 3·4 per cent. in C_2H_5Cl. (4) The specific heat at constant volume for CO_2 increases by about 29 per cent. for a rise from 0° to 500° C. [See also Abstracts Nos. 1703 (1904) and 1743 (1906).] E. H. B.

88. *Radiation Theory.* **J. H. Jeans.** (Phys. Zeitschr. 9. pp. 853–855, Dec. 1, 1908.)—A defence of the equal-distribution-of-energy hypothesis leading to the expression for radiation—

$$8\pi RT\lambda^{-4}d\lambda,$$

against Planck's theory which leads to the radiation formula—

$$\frac{8\pi c d\lambda}{\lambda^5(e^{c/RT\lambda}-1)}.$$

[See Abstract No. 1453 (1908).] E. H. B.

89. *Behaviour of Heated Palladium Foil.* **H. V. Gill.** (Cambridge Phil. Soc., Proc. 14. pp. 578–579, Nov. 20, 1908.)—A piece of palladium foil about 1 in. long and ⅛ in. wide was heated by means of an electric current in a vacuum tube; the temperature gradually rose, the pressure of the air in the tube being about 0·15 mm. When the Pd was white hot there became visible around it a glow, not unlike the "negative glow" in a vacuum tube discharge. There was, however, no electric field except that due to the current from two storage cells employed to heat the foil. The glow is of a rich purple-blue colour, and there appeared to be a "dark space" between the hot metal and the glow, but this is not certain. Further experiments are in progress to investigate the effect observed. J. J. S.

90. *Standardisation of Temperatures by means of Boiling-points of Pure Substances: Vapour Pressure of Oxygen at Three Temperatures.* **H. Kamerlingh Onnes** and **C. Braak.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 833–841, Nov. 26, 1908.)—In these measurements of the vapour pressure of oxygen at temperatures near its boiling-point, the authors employ the new form of cryostat previously used [compare Abstract No. 81 (1907)]. By this means they find that the mean results obtained for the vapour pressure when (1) a small, and (2) a large quantity of oxygen is employed differ by not more than 0·1 mm., corresponding with 1/800°. From these results it is concluded

that a vapour-pressure apparatus is well suited to the standardisation of temperatures, such an apparatus surpassing in accuracy the gas thermometer, and probably also the resistance thermometer. The boiling-point of oxygen at 760 mm. pressure at sea-level and 45° N. latitude is found to be —183·087° on the normal hydrogen thermometer and —182·986° on the absolute scale; it is probable that this value does not differ from the true value by more than 0·03°. The vapour pressure of oxygen at —186·542° is 516·19 mm. and at —189·442°, 366·24 mm. at sea-level, and 45° N. latitude. Comparison of these results with those obtained by Travers, Senter, and Jaquerod [Abstract No. 1025 (1903)] shows a systematic difference. **T. H. P.**

91. *A Recalculation of the Vapour Pressure of Mercury.* **T. H. Laby.** (Phil. Mag. 16. pp. 789–796, Nov., 1908.)—From the existing data, the author has recalculated the values of the vapour pressure of mercury, and tabulated the values for temperatures from 15° C. to 450° C. They are as follows:—

VAPOUR PRESSURE OF MERCURY (IN MM. OF MERCURY AT 0°).

Temp. °C.	Pressure.	Temp. °C.	Pressure.	Temp. °C.	Pressure.	Temp. °C.	Pressure.
15	0·000691	110	0·465	205	20·89	300	248·6
20	0·00109	115	0·597	210	24·42	305	276·9
25	0·00168	120	0·761	215	28·46	310	307·7
30	0·00257	125	0·965	220	33·08	315	341·4
35	0·00387	130	1·215	225	38·28	320	378·1
40	0·00574	135	1·52	230	44·10	325	418·0
45	0·00840	140	1·89	235	50·78	330	461·3
50	0·0122	145	2·34	240	58·16	335	508·3
55	0·0174	150	2·88	245	66·50	340	559·1
60	0·0246	155	3·58	250	75·88	345	614·1
65	0·0344	160	4·30	255	86·24	350	673·3
70	0·0476	165	5·218	260	97·82	355	737·2
75	0·0652	170	6·298	265	110·7	360	805·9
80	0·0885	175	7·567	270	124·8	365	879·8
85	0·1191	180	9·054	275	140·8	370	959·2
90	0·1589	185	10·78	280	158·4	380	1135
95	0·210	190	12·80	285	177·9	390	1337
100	0·276	195	15·12	290	199·8	400	1566
105	0·360	200	17·81	295	222·8	450	3229

Intermediate values over a range of 5° can be obtained by linear interpolation of log p against t. **A. F.**

92. *Condensation of Water Vapour in the Gas Evolved from the Pozzuoli Crater.* **A. Lo Surdo.** (N. Cimento, 16. pp. 315–319, Oct., 1908.)—The author has examined the effect, in the production of cloud in the gas evolved from the crater, of nuclei belonging to three groups, viz., (1) ions produced by Röntgen or Becquerel rays, (2) ions formed by oxidation of phosphorus, and (3) nuclei produced by an incandescent Pt wire. In the case of the first, no appreciable condensation took place, but with both the other groups of nuclei, considerable clouding occurred. The failure of Röntgen or Becquerel rays to cause cloud is attributed to condensation of this character having already taken place in the crater, since the gas is distinctly radio-active. **W. H. St.**

93. *Discontinuity of Temperature at the Boundary of Two Bodies. Note on Kolovrat-Červinskij's Experiments.* **E. Rogovskij.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 218–218 [Physical Part], 1908.)—From the results of the author's experiments [see Abstract No. 1440 (1905)], it follows that the difference between the temperature of water and that of a silver wire plunged into it and heated by a current, increases with the flux of heat across the surface of separation. The great value of this difference (24·4°) is ascribed by the author to the enormous flux, namely, 9 gm.-cals. per sec. per cm.^{2}. In Kolovrat-Cervinskij's experiments [Abstract No. 1452 (1908)], the flux between the water and mercury did not exceed 0·0468 gm.-cals. per sec. per cm.^{2}, and the difference of temperature did not exceed 0·185°; in the conditions obtaining in the author's experiments the difference of temperature corresponding with the flux 0·0468 is 0·87°, whilst Kolovrat-Červinskij found 0·085°. In the latter case, however, the water and mercury were motionless, which diminishes the temperature difference; the use of thermo-elements of good conducting metals diminishes it still more and makes it negative in most of these experiments, the heat passing from the colder to the hotter body. T. H. P.

94. *The Additions Theorem of Entropy.* **M. Laue.** (Phys. Zeitschr. 9 pp. 778–780, Nov. 1, 1908.)—The thorem considered by the author is that the entropy of any system is equal to the sum of the entropies of its parts divided in space, or at all events can be calculated if the entropies of the parts are known. The thorem lies at the foundation of Thermodynamics, and is required, so says the author quoting Planck, in the proof of the much vexed, second law of Thermodynamics—namely, in the differential form $dE = (1/T)(dU + p dV)$ in which T denotes temperature, U energy, and p, V pressure and volume respectively. As there are systems not sufficiently "ungeordnet" for p and T to have any meaning, he would substitute for the last equation Boltzmann's $E_1 = k \log W_1$, $E_2 = k \log W_2$, in which the system of two parts has entropies E_1 and E_2 of the two parts respectively; k is a universal constant, and W_1, W_2 are the number of arrangements (Komplexionen) possible for the parts respectively. This is consistent with the additions thorem $E = E_1 + E_2$. He goes on to show that in radiations these relations do not hold. He considers the case of a pencil of rays having intensity K, incident on a reflecting plane. Consider the plane as at right angles to the plane of the paper, and to the lines of writing, and the rays in the plane of the paper. There is a reflected part having intensity $K_1 = rK$ and a refracted part having intensity $K_2 = (1 - r)K$. These are reflected again from two mirrors symmetrically situated with respect to the plane, and both perpendicular to the plane of the paper, and so are both again incident on the principal plane in the same plane of incidence. We have, the author says, two new pencils whose intensities are K_1' and K_2'. By the equation of energy $K_1' + K_2' = K$. But if the reflecting power of the mirrors r' is the same as that of the principal plane and $r < \frac{1}{2}$, $K_1' - K_2' > K_1 - K$. It follows that the temperature for K_1' is greater than for K_2'—or one of the two pencils has gained in temperature at the expense of the other—and this without compensation, which is contrary to the second law. Also by making $r' = 1 - r$, he obtains the result that the additions thorem does not hold in this case. S. H. B.

95. *The Kinetic Derivation of the Second Law of Thermodynamics.* **O. Postma.** (Konink. Akad. Wetensch. Amsterdam, Proc. 11. pp. 303–314, Nov. 26, 1908.)—The author amplifies a preceding paper [see Abstract No. 858 (1907)].

He obtains the result that every arbitrary group of molecule systems having purely kinetic energy, proceeds in general towards a state where uniform distribution in space and Maxwell's distribution of velocities frequently occur. He points out the important differences between his method and Boltzmann's. In order to get a kinetic derivation of the second law of thermodynamics it is necessary to define kinetically a quantity analogous in its properties with thermodynamic entropy. Lorentz and Gibbs have defined such quantities, the former having shown how Boltzmann's integral can be made to satisfy the required conditions. The author shows how to make Gibbs' entropy consistent with these conditions. A. R.

96. *Brownian Motions in Various Media.* **V. Henri.** (Comptes Rendus, 147. pp. 62–65, July 6, 1908.)—Rubber emulsions showing Brownian motions are coagulated into a network by acids, and agglutinated into droplets by alkalies. The author took micro-kinematograms of emulsions to which small quantities of hydrochloric or acetic acid, soda, urea, or alcohol had been added. He found that the addition of a coagulating substance retards the motions before coagulation sets in. Acids may be made to reduce the range of motion ninefold as compared with distilled water. The ions H and OH are not the determining agents, since alcohol also retards before coagulation. The real cause of retardation is an adsorption of alkali or acid by the granules, especially the latter. E. E. F.

97. *Osmotic Pressure and Brownian Motions.* **J. Duclaux.** (Comptes Rendus, 147. pp. 181–184, July 13, 1908.)—A criticism of Perrin's work [Abstract No. 1816 (1908)]. Gamboge is not quite insoluble, and the density of the particles is more like 1·24 than 1·35. The concordance between theory and fact found by Perrin is perhaps accidental. The study of true colloids shows that the kinetic energy of particles is not the only quantity to be considered in osmotic pressure. The electrostatic changes of particles exert a predominant influence, especially in coagulation. E. E. F.

REFERENCE.

98. *Vapour Pressure of Water and Ice.* **N. Ekholm.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 29. pp. 1–75, 1908.)—An important paper which gives a full discussion of the determinations of the vapour pressure of water and ice, formulæ for interpolation, and a table of the recalculated values of vapour pressure from 100°–365° C. The paper also contains tables of integral logarithms. A. F.

SOUND.

99. *Secondary Vibrations.* **L. I. Kordyš.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 245–260, and pp. 270–298 [Physical Part], 1908.)—The author discusses the mechanism of the origin and propagation of secondary vibrations, and of their recognition by means of the ear or such devices as resonators, telephonic membranes, &c. These questions are discussed under two headings: I. *Physical Conditions for the Simultaneous Formation of Vibrations of Various Kinds.*—It is concluded that neither the supposition that different parts of a body emitting waves are under varying conditions of vibration, nor the assumption that each vibrating particle of the body is the centre of emission of a whole series of waves with different periods, is admissible. II. *Physical Conditions of the Transmission of these Vibrations by the Medium.*—The hypotheses usually introduced to give a possible explanation of various acoustic phenomena are insufficient to explain numerous observations, and are, besides, quite incomprehensible from a physical point of view. This applies, for example, to Helmholtz's theory of resultant sounds. The integral of the equation $d^2\eta/dt^2 + n^2\eta + \beta\eta^2 = A_1 \cos v_1 t + A_2 \cos (v_2 t - \delta)$, which expresses Helmholtz's theory, can only have a physical meaning when it has a finite magnitude. But this integration gives an infinite series, of which it seems impossible to find the general term, although it can be shown that most of the terms form an infinite series. Further, the consequences of Helmholtz's theory cannot be represented at all concretely. Calculation of the amplitudes of the secondary sounds gives results in complete disaccord with the experimental values. T. H. P

100. *Beats and their Resultants.* **G. Zambiasi.** (N. Cimento, 16. pp. 65–81, July–Aug., 1908.)—Two sounds heard by one ear each do not exhibit beats. This applies not only to feeble sounds, but also to strong sounds of a high pitch. The two sounds produce, however, a difference tone, which is particularly clear when the two sounds meet in the air before they reach the ears. The method of beats for comparing pitches is most sensitive when the beats occur at intervals of about 4 seconds. This applies both to acoustical and optical methods of counting beats. E. E. F.

101. *Contributions to the Study of Audition.* **Marage.** (Comptes Rendus, 147. pp. 646–649, Oct. 12, 1908.)—The most recent theory of audition postulates that all the nerve endings of the inner ear are equally affected by all the vibrations which reach them, and that it is the different centres of the brain that react to special impulses and thus produce different impressions of sound. This theory is borne out by our anatomical knowledge, and also by pathological observations. The vestibular nerve which corresponds to the anterior root ends in the nucleus of Deiter and in the vestibular nucleus, whilst the posterior root or cochlea nerve is connected by different branches with eight different nuclei. Bechteren divides these branches into centripetal auditory paths of 1st, 2nd, and 3rd order, which directly connect the cochlea with the different centres. In addition, there are recurrent or centrifugal paths which connect the different nuclei together. Pathologically, cases are met with in which the subject can hear the faintest noise but is completely deaf to musical

sounds and words, others in which noises and words are heard but not understood. Lastly, there are cases of rapidly increasing deafness which begin, for example, by failure to hear certain instruments in an orchestra; then follows deafness to all musical sounds; next, words are not understood; and finally, deafness becomes absolute. These phenomena may be explained by the above theory by supposing that one or more of the different centres become impaired while the others remain active. H. W. P. Y.

102. *Intensity of Sound.* **G. Ercolini.** (N. Cimento, 16. pp. 45–64, July-Aug., 1908.)—By means of two telephones, compared with each other under various conditions as to distance and supply of energy, the author endeavours to determine the law according to which the loudness varies with the distance. Equality of loudness, rather than extinction, is relied upon for comparisons. The conclusion provisionally arrived at is that, whatever may be the law of loudness for strictly spherical waves, in the ordinary sources of sound the physiological intensity is more nearly inversely proportional to the distance than to the square of the distance, and more nearly proportional to the amplitude than the square of the amplitude. To obtain spherical waves the author suggests the use of the singing arc, and for graduating intensities he suggests the use of an interference tube. E. E. F.

103. *Different Traces from the Same Vowel sung.* **Marage.** (Comptes Rendus, 147. pp. 921–923, Nov. 16, 1908.)—The author considers that the fundamental French vowels *ou, o, a, e,* and *i* are formed in the larynx, reinforced or transformed by the buccal cavity, and that *a* is characterised by vibrations in three groups, *e* and *o* by two groups, and *i* and *ou* by one group. Owing, as he believes, to imperfect enunciation, the traces obtained for any one of these vowels when sung to a given note differ from one another. [See also Abstract No. 881 (1908).] E. H. B.

104. *König's Theory of Striæ in Kundt's Dust Figures.* **J. Robinson.** (Phys. Zeitschr. 9. pp. 807–810, Nov. 15, 1908. From the English.)—König gave a theory of the formation of the striæ in Kundt's figures which involved the forces acting on neighbouring spherical particles in the dust along the tube. Riecke suggested a method of testing the theory, which is adopted in the present work. Iron filings are used for the dust figures, and a magnetic field is applied to note whether any deformation of the striæ thereby results. A number of details are given showing the effects with fine and coarse iron filings and other materials. It is found that the intensity of the sound has much influence on the figures; but for that, it is believed that a yet closer agreement with König's theory would have been observed. E. H. B.

105. *End Correction for Open End with Infinite Flange.* **K. Aichi.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 19. pp. 877–882, Sept., 1908.)—The correction for the open end is an important quantity in the theory of organ-pipes, and also in problems of electrical conductivity. There are two methods of evaluation. That due to Helmholtz consists of an exact solution for an approximate cylinder. That due to Rayleigh considers a true cylinder, and finds that the correction must lie between 0·785 R and 0·82422 R, where R is the radius of the cylinder. The slightly different method of approximation used by the author of the present paper finds for this upper limit the smaller value 0·82286 R. E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

106. *Mechanical Significance of Maxwell's Equations.* **V. Bjerknes.** (Ark. för Mat. Astron. och Fysik, Stockholm, Vol. 4. No. 8. pp. 1–7, 1908.)—Maxwell's equations for the electromagnetic field are closely akin to those based upon mechanical considerations and used by Fresnel and his successors in treating optical phenomena. This relationship has led, on the one hand, to Maxwell's electromagnetic theory of light and, on the other hand, to many endeavours to give to Maxwell's equations a mechanical significance. But these endeavours have hitherto met with but little success. For, first of all, it is required that such a mechanical theory shall account for the mechanical forces which form so important a part in all our experience of electromagnetic phenomena; and this has not yet been accomplished. The present author now attempts to fill this want by postulating an ether which possesses inertia and which, when moving, is in a state of tension or strain. If simple proportionality between twist and couple is assumed the gyrostatic ether of MacCullagh and Kelvin is reached. But the assumption is now introduced that in the relation between stress and strain, terms of the second order must be retained. It is then found that, according to the equations of the electromagnetic field, this *new gyrostatic ether* moves in such a way as to develop forces *equal and opposite* to those of this field. E. H. B.

107. *Ratio of Charge to Mass for Mercury Vapour.* **R. Fürstenau.** (Phys. Zeitschr. 9. pp. 849–852, Dec. 1, 1908.)—By the kinetic theory of gases, thermodynamic considerations and the expressions of Drude and of Lorentz for the electric conductivity of gases, the present author finds for the ratio of electric charge to mass for the molecules of mercury vapour the two values 47·8 and 88·4, whence for hydrogen he calculates the values $e/m = 9{\cdot}88 \times 10^3$ (Drude), and $e/m = 7{\cdot}62 \times 10^3$ (Lorentz). W. Wien has experimentally found by canal rays in pure hydrogen the value $e/m = 9{\cdot}53 \times 10^3$. Again Drude's value for the ratio of thermal conductivity (k) to electric conductivity (κ) is given by $k/\kappa = 6{\cdot}479 \times 10^{10}$, whereas Lorentz's value of the same ratio is $k/\kappa = 4{\cdot}819 \times 10^{10}$. The experimental value of Diesselhorst and Jaeger is $k/\kappa = 6{\cdot}71 \times 10^{10}$. Hence in each of the cases here considered Drude's values are favoured. [See also Abstracts Nos. 577, 1446 (1905).] E. H. B.

108. *Electric Units and Standards.* **Devaux-Charbonnel.** (Électricien, 36. pp. 372–379, Dec. 12, 1908.)—The adoption of the ohm and the ampere as the primary units by the International Conference held in London (1908) is considered to be a mistake. The true industrial units are the ohm and the volt, and it is difficult to see why these units were not adopted. It is pointed out that, given a standard resistance, the e.m.f. of a Weston cell can be determined to a higher degree of accuracy than the weight of the silver deposited in a voltameter by a known current. It seems illogical at first sight to elevate the volt to the rank of a primary unit whilst the ampere which served to determine it ranks as a secondary unit. Still, as it is impossible to give a concrete representation of the ampere, it is rational to choose the most

accurate of the indirect methods of indicating it. The author believes that the resolutions adopted at the London Conference are regrettable from the point of view of the interests and the needs of the electrical industry. A. R.

109. *The Energy stored in the Electric and Magnetic Fields.* **P. G. Agnew.** (Science, 28. p. 784, Nov. 20, 1908.)—The author gives a method of proving the formulæ for the energy stored in electric and magnetic fields. If we have a sphere of radius r with a charge q, then the electrostatic energy E due to this charge is $q^2/2r$, and the volume of the sphere v is equal to $(4/3)\pi r^3$. Hence $dE/dv = -(1/8\pi)(q/r^2)^2 = -R^2/8\pi$, where R is the intensity of the field at the surface of the sphere. It thus follows that the energy in ergs per unit volume of the field is $R^2/8\pi$. In a similar way we can show that $H^2/8\pi$ gives the energy per unit volume in a magnetic field of intensity H. It is easy to see that if λ be the dielectric coefficient, the formula for the electrostatic energy is $\lambda R^2/8\pi$, but the proof of the corresponding magnetic expression $\mu H^2/8\pi$ is much more difficult. A. R.

110. *Electric Fields and Displacements in Insulators moving in a Magnetic Field.* **S. J. Barnett.** (Phys. Rev. 27. pp. 425–472, Nov., 1908.)—From the classical experiments of Ampère and Rowland it follows that an electrified particle with charge q moving with velocity v in a magnetic field at a point where the induction is B is acted upon by a force F equal, if suitable units are used, to the product of the charge q by the vector product of the velocity v and the induction B. That is, $F = qVvB$...(1). Hence if ether or matter is electrically constituted and moves in a magnetic field, each moving electrified constituent is acted upon by an electromagnetic force in accordance with (1), *i.e.*, the moving substance is the seat of an intrinsic electric intensity f, the "motional intensity" of Heaviside, given by $f = F/q = VvB$...(2). The relative displacement of the oppositely electrified constituents of the moving substances produced by the motional intensity f gives rise to an electric field; and the intensity E of this field acts on all dielectrics which the field contains, whether at rest or in motion. If both ether and matter move, both intensities act on both substances. But if the ether remains fixed and the matter moves through it, the intensity f acts on the matter only, while the field intensity E acts on both the ether and the matter. The electric displacement, if the matter is insulating, depends only on the two intensities and on the dielectric constants of the matter and the ether. In the author's experiments, carried out with elaborate care and precautions, a hollow cylinder of the substance under examination was mounted on a rotor of bronze, the whole rotating inside the coil which produced the magnetic field. The resulting p.d.'s were ascertained by an electrometer. The behaviours of sulphur, rosin, paraffin, spermaceti, and ebonite were investigated, positive effects being in each case observed, which are nearer to the values to be theoretically expected on the theory of Lorentz than on the ether-motion theory. E. H. B.

111. *Action of an Electrically Charged Point upon a Candle-flame.* **V. Chiarini.** (N. Cimento, 16. pp. 820–821, Oct., 1908.)—When an electrically charged point is brought near the luminous part of a candle flame, the latter is repelled if the charge is positive, and attracted if it is negative. By placing a negatively charged point nearer the wick, and inclined at an acute angle thereto, complete repulsion of the flame takes place. Similar results may be obtained by electrifying the flame, and bringing a point conductor, connected to the earth, up close to it. (Ibid. p. 822, Oct., 1908.)—When a candle flame is placed between two metallic plates connected to the conductors of an electrostatic machine, it becomes divided into two tongues, the smaller of which is yellow and inclined towards the positive disc, while the larger is red and bent towards the negative plate. A galvanometer inserted in the wire connecting a pole of the machine with either plate shows the existence of a current during the whole time the machine is working, a double circulation of positive and negative charges taking place. W. H. Sr.

112. *Dispersion of Electricity.* **A. Campetti.** (N. Cimento, 16. pp. 184–188, Sept., 1908.)—The author has investigated the effect of moisture in the surrounding air and in the substances examined, on some experiments by Pacini [Abstract No. 1062 (1907)] as to the discharging power of certain salts when crystallised on a strip of blotting-paper and wound on a coil, between two coaxial cylinders maintained at different potentials. Preliminary experiments showed that unless the air surrounding the cylinders was in the same hygrometric state, no reliable conclusions could be drawn from the discharge, and special precautions were subsequently taken to ensure this. With no salt on the discharging coil, the rate of discharge was the same in dry air as in air saturated with water. The salts examined were copper sulphate, calcium chloride, potassium bichromate, and quinine bisulphate, none of which, when anhydrous, shows any polarity in dry air. In moist air the rate of discharge becomes altered, the change being different for a positive or negative charge. Denoting by K the ratio of the time necessary for a given fall of potential in moist air to that in dry air, its value for copper sulphate is about 1·6; for calcium chloride, 0·9 for a positive charge; for potassium bichromate, 1·5 for a negative charge; and for quinine bisulphate, 1·8 for a positive charge. The rate of discharge is not appreciably affected with calcium chloride for a negative charge, with potassium bichromate for a positive charge, and with quinine bisulphate for a negative charge. W. H. Sr.

113. *Atmospheric Electricity.* **E. v. Schweidler.** (Akad. Wiss. Wien, Sitz. Ber. 117. 2a. pp. 653–664, May, 1908. From the II. physikal. Inst. d. k.k. Univ., Wien.)—This paper gives a theoretical discussion of the distribution of ions in the lowest layers of the atmosphere. The author concludes that there must be a considerable and rapid variation in the field intensity, and also of the number of ions in the lowest layers of the atmosphere. Tables are given of the values at different heights, assuming certain values for the normal summer and winter potential-fall close to the ground. There may be a decrease of as much as 60 per cent. in the first 20 m. from the ground, but at greater heights the variation is slow, a result in agreement with Gerdien's balloon experiments. A. W.

114. *Number of Ions in the Atmosphere near Hot Springs.* **D. Isitani.** (Mathematico-Physical Soc., Tōkyō, Proc. 4. 19. pp. 370–377, Sept., 1908.)—A record of observations made at several mineral springs in the provinces of Izu, Kôtsuke, and Shimotsuke, in Japan, during 1907–1908, by means of an Ebert aspiration apparatus. Most of the observations were made under abnormal conditions, and they show that the numbers of positive and negative ions in free atmosphere, as well as their ratio, are influenced considerably by atmospheric conditions. The few observations made under nearly normal conditions of the atmosphere gave for the mean

densities the values: $n_+ = 1{,}920$, $n_- = 1{,}840$, $q' = 1\cdot 08$, where n_+ is the mean number of positive ions per c.cm., n_- the number of negative ions, and q' the ratio n_+/n_-. G. E. A.

115. *Continuous Luminous Discharge during a Thunderstorm.* **Nicolas.** (Comptes Rendus, 147. pp. 1011–1012, Nov. 23, 1908.)—During a severe thunderstorm in the Loyalty Islands during the night of July 4, 1908, the lightning, which had been very vivid, was replaced by a series of luminous electric discharges from all objects, resembling a brush discharge but unaccompanied by any crackling sound. The discharges lasted each for about 20–40 sec., and succeeded one another at intervals of 2–3 sec. The rainfall, which had also been exceedingly heavy, diminished when the discharges commenced. The phenomenon lasted from 4.30 till 6 a.m.; it was observed simultaneously at places 80 km. apart, and probably extended over the whole island. R. G. K. L.

116. *Balloon Observations of Atmospheric Radio-activity.* **S. Flemming.** (Phys. Zeitschr. 9. pp. 801–803, Nov. 15, 1908. Inaug.-Dissertation, Techn. Hochschule, München, 1908.)—An insulated wire about 10 m. long was carried by a balloon to heights varying up to 3,500 m. The wire was charged to a potential of 2,000 volts, and after exposure (usually for an hour) its activity was measured. The results obtained are tabulated, the temperature, barometric pressure, &c., being also given, and the results are discussed. A marked feature is the high value of the activity of the wire obtained between 2 and 4 o'clock in the afternoon. A. W.

DISCHARGE AND OSCILLATIONS.

117. *Specific Charge of the Ions emitted by Hot Bodies.* **O. W. Richardson.** (Phil. Mag. 16. pp. 740–767, Nov., 1908.)—The value of e/m, the specific charge or charge per unit mass of the positive ions from hot bodies, was directly investigated, the method employed being that of the direct measurement of the deflection of the path of the ions, moving in a uniform electric field, arising from the application of a transverse magnetic field. The mean corrected value of e/m for the positive ions from hot platinum was found to be 384, for those from carbon $e/m = 353$. The values of m/H the ratio of the mass of an ion to the mass of a hydrogen atom were for Pt 25·7 and for carbon 27·6. These numbers are nearly the same, and the value of m/H for iron found by J. J. Thomson was about 24. While it cannot be said what the ions are, they are not atoms of the metal (for this would have involved a great variation in the value of m for the elements investigated), nor atoms or molecules of absorbed hydrogen, because the value of m/H is far too high, nor for the same reason can they be the positive electrons in the canal rays. The ions appeared to be quite homogeneous, and the majority of them were comparatively heavy. There seems no indication that the value of e/m depends on the temperature of the hot body in any definite way. The values of m would be doubled if it were assumed that the positive ions carried twice the charge of an electrolytic hydrogen atom, as Townsend has recently found to be the case for the positive ions produced by Röntgen rays in air. It is possible that the ions arise from some impurity which is common to all the materials which have been examined. The value of e/m for sodium atoms would be near that which has been observed. It is possible that the positive

ionisation in a vacuum is due to a real constituent which is common to the different elements examined, as opposed to some foreign substance whose presence is accidental, but in this case it would have to be assumed that the ions carry a charge which is smaller than the accepted fundamental electronic charge *e*. It is intended to carry out further experiments. J. J. S.

118. *Kathode Rays.* **J. Classen.** (Phys. Zeitschr. 9. pp. 762–764; Discussion, pp. 764–765, Nov. 1, 1908. Paper read before the 80. Naturforscherversamml., Köln. Deutsch. Phys. Gesell., Verh. 10. 20. pp. 700–704, Oct. 30, 1908.)—Describes a new determination of e/m for kathode rays. The method was the usual one of observing the deflection in a magnetic field. To obtain a field as uniform as possible, two large coils of 28 cm. mean radius with 900 turns in 30 layers were used. For a current of 1 amp. these gave a field of 28·83 gauss, constant to 1 per cent. for a distance of 4 cm. along the axis and for a radius of 5 cm. The tube, of special shape, was placed in this space, so that the rays were acted on by the uniform field, and the deflection was observed photographically. The mean of 17 measurements, the potential applied being 1,000 volts, gave a value for e/m of 1·774, the greatest difference from the mean value being 0·004. Observations were also made for higher potentials, and for the ratio m_{4000}/m_{1000} the values 1·008, 1·010, 1·006, 1·004 were obtained. The theory of Lorentz gives for this 1·006. In the *discussion* the author's method and results were compared with those of Kaufmann and Simon, who obtained somewhat greater values for the ratio e/m. A. W.

119. *Observations on Canal Rays.* **J. Stark.** (Deutsch. Phys. Gesell., Verh. 10. 20. pp. 713–725, Oct. 30, 1908. Paper read before the 80. Naturforscherversamml., Köln., Sept., 1908.)—The paper is an account of the reasoning which led the author to make certain experiments upon the Doppler-effect in canal rays, the account of the experiments to be published later. According to M. Planck's theory of the distribution of energy in the case of radiation [see Abstract No. 507 (1901)], the radiation by a positive ion in the canal rays should not begin until the kinetic energy of translation reaches a certain limiting value, and then for higher values it should not occur again until twice this value of the kinetic energy is reached, and so on. The spectrum for the Doppler-effect should consequently consist of two displacement lines, in addition to the "rest" line, and the author finds, with the greater dispersive power now at command, the displacement portion exhibits two maxima, from which he is able to calculate the two limiting velocities necessary for emission of the three lines H_β, H_γ, and H_δ, and these are fairly in accordance with Planck's theory. It is pointed out that the duplex character of the Doppler-effect was first observed by Paschen [see Abstract No. 1848 (1907)], but the explanation there given differs from the author's. The advantages in the latter are pointed out. Also, according to Planck's theory, a third line should be present, and this has been observed by the author in the case of the line H_δ when the kathodic p.d. exceeds 3,600 volts. S. G. S.

120. *Potential Measurements in the Kathode Dark Space with Glowing Oxide Kathodes.* **W. Westphal.** (Ann. d. Physik, 27. 3. pp. 571–588, Nov. 10, 1908.)—This is an extension of a previous paper [see Abstract No. 1464 (1908)]. As the oxide kathode is raised in temperature, it emits more and more electrons, so that the excess of positive ions in the kathode dark space is more and more neutralised, and the potential gradient in the dark space

becomes more and more linear. This is proved by experiment. The potential is obtained by the probe method. When the kathode is white hot, the potential gradient is linear, the kathode fall is very small, and at the boundary of the negative glow the potential gradient shows a sudden change. The equipotential planes are found to be of the same form as for cold kathodes. To test the validity of results obtained by the probe method, photographs of the path of the kathode rays in magnetic fields are taken, and from these conclusions drawn as to the potential gradient. The results indicate that the probe method is reliable. In addition to what has been stated the experiments show that conclusions drawn from results with glowing kathodes hold also for cold kathodes, and that Poisson's equation is applicable to gases in a discharge tube. T. P. B.

121. *Dispersion in the Electric-spectrum of Ethyl Alcohol.* **A. R. Kolli [Colley].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 121–136 [Physical Part], 1908.)—As was shown in investigating the electric spectrum of water [Abstract No. 959 (1908)], in the region of abnormal absorption the magnitude of the refractive indices depends largely on the damping of the vibrations. The author shows how to measure accurately the indices of refraction in this region of abnormal absorption, and studies also the course of the dispersion when the damping is magnified artificially. The results show that, as the damping is increased, the dispersion bands become less marked and are displaced towards the shorter waves. The max. absorption is observed in the lower part of the dispersion bands. The relation between the refractive index and the concentration of the alcohol is also shown for various wave-lengths and temperatures; all the curves representing this relationship exhibit bulges at the same concentrations. T. H. P.

122. *Dispersion in the Electric Spectra of Benzene, Toluene, and Acetone.* **A. R. Kolli [Colley].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 228–244 [Physical Part], 1908.)—The author has investigated the electric spectra of benzene, toluene, and acetone, a method being used which permits of accurate measurements with small troughs in the case of liquids with low refractive indices. The results, which are given in the form of tables and curves, bring out the intimate chemical relationship between toluene and benzene, two bands being common to the two spectra. Further, the spectra of toluene and acetone also exhibit one common band, which must be regarded as typical for the methyl group [see Abstract No. 959 (1908)]. T. H. P.

123. *Diffraction of a Plane Electric Wave at an infinitely Long Metal Cylinder of Elliptical Cross-section.* **B. Sieger.** (Ann. d. Physik, 27. 3. pp. 626–664, Nov. 18, 1908.)—The object of the paper is to obtain a mathematical expression by which it will be possible to calculate the diffraction effects, when a plane-polarised wave falls upon the broad side of an infinitely long metal cylinder of elliptical cross-section. It is assumed that the cylinder is a perfect reflector and that the electric field is parallel to the length of the cylinder. The paper is a long one, and its mathematical nature does not permit of its being fully abstracted. At the end, the solution, which is obtained for the problem, is applied to calculate the field intensity at varying distances from the cylinder, when it is assumed that the latter has become an infinitely thin strip of breadth $1/\pi$ times the length of the incident wave. In front of the strip, on a line perpendicular to it at its mid-point, there are maxima and minima, of which the intensity gradually merges into that of the incident wave, as the distance from the strip increases. Behind the strip on the same line the intensity gradually increases from nothing to that of the incident wave. On a line perpendicular to the strip, but in its plane, there are again maxima and minima of gradually decreasing intensity. These results are shown also in curves. T. P. B.

124. *Hertz's Experiments using the Duddell Arc.* **N. Ščodro.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 303–305 [Physical Part], 1908.)—By means of a Duddell arc, the author has obtained electric waves with λ less than 1 m., and having much greater energy than those obtained by means of an induction coil. By means of a Boltzmann mirror placed at a distance of 8 m. from a Hertz mirror, interference curves were obtained similar to those obtained by Klemenčič and Czermak (Wied. Ann. 50. p. 185, 1893). T. H. P.

125. *Mechanically-produced Conductivity of a Coherer.* **R. Thöldte.** (Deutsch. Phys. Gesell., Verh. 10. 21. pp. 845–858, Nov. 15, 1908.)—Continuing an earlier research [see Abstract No. 821 (1907)] the author investigates coherence in various oils and finds that, for conductivity to be established, the parts of the coherer must be brought so near each other that a discharge takes place, and so the insulating medium is carbonised. Carbon is found on the negative pole. T. P. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

126. *Electrical Conductivity of Liquid Sulphur.* **A. Wigand.** (Deutsch. Phys. Gesell., Verh. 10. 13. pp. 495–508, July 15, 1908.)—The author finds that the electrical conductivity of liquid sulphur does not alter in value under the influence of light, and hence infers that the electrical conductivity has the same value for the soluble as for the insoluble form of sulphur. The conductivity of liquid sulphur increases uniformly with the temperature up to a maximum at 150°; it then decreases rapidly till it reaches a minimum between 160° and 170°, when it again begins to rise, and continues rising up to the boiling-point of sulphur. The author is of opinion that the measured conductivity of molten sulphur is due to traces of impurities such as sulphur dioxide. D. H. J.

127. *Light-sensitive Gas Cell.* **J. Rosenthal.** (Phys. Zeitschr. 9. pp. 803–804, Nov. 15, 1908.)—Describes the construction of a gas cell quicker in action than the selenium cell and with a greater current strength. The electrodes are of rubidium, which is sensitive to electric light. During evacuation the anode is heated, and then the cell is filled either with hydrogen or helium. The rubidium-helium cell has advantages over the rubidium-hydrogen form. A. W.

128. *The Bose Phenomena and the Laws of Contact Electrification.* **E. Guillaume.** (Comptes Rendus, 147. pp. 53–55, July 6, 1908.)—According to Bose, a metallic thread immersed in an electrolyte exhibits a momentary e.m.f. when twisted sharply in the liquid; if the thread is twisted several times in succession the intensity of the e.m.f. diminishes, but recovers its value if the wire is left to itself for a time before twisting. This phenomenon is called the "fatigue" of matter. According to the present author the

phenomenon is connected with the existence of a film on the surface of the wire, and it is not necessary to attribute to inorganic matter the properties of living matter. If the metal (*e.g.* Pt) is not acted on by the electrolyte no e.m.f. is developed by twisting the pure metal; the Pt wire will, however, exhibit an e.m.f. under otherwise similar conditions if first coated with a film of hardened kaolin or a thin layer of gelatine. Metals like copper, zinc, &c., exhibit the Bose phenomenon owing to the existence of a very thin greyish surface-coating. D. H. J.

129. *The Bose-Guillaume Phenomenon and Contact Electrification.* **J. Perrin.** (Comptes Rendus, 147. pp. 55–56, July 6, 1908.)—The author suggests the following explanation of the development of an e.m.f. on twisting a metal wire which has been covered with a porous film and placed in an electrolyte: When the coated wire is immersed in the electrolyte it becomes charged by contact along its very large surface. The liquid which impregnates the porous film contains an excess of ions of the opposite sign. On twisting the thread a little of the charged liquid is squeezed out of the spongy film, whence results a momentary p.d. D. H. J.

130. *E.M.F. of Thermo-currents in Powdered Conductors of the Second Kind.* **A. M. Iljev.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 220–227 [Physical Part], 1908.)—The author has investigated the currents generated when two compressed tabloids of a powdered substance, one at the ordinary temperature and the other at 100°, are joined by a metallic connection. In the following series of substances, with which the current has the same direction as the fall of temperature, the intensity of the current increases from the first to the last member: soot, iridium oxide, wood-charcoal, graphite, antimony, ferrous sulphide, copper pyrites, carborundum, cupric sulphide, green nickel oxide, manganese dioxide, pyrites, cupric oxide, stannous sulphide, black nickel oxide, molybdic acid, tungstic acid. Negative currents are given by graphitic charcoal, uranium oxide, thallic oxide, lead dioxide, silicon, pyrolusite, vanadic acid, mercuric oxide, titanic acid. T. H. P.

131. *Determination of the Constant of an Absolute Electrodynamometer.* **A. Guillet.** (Soc. Int. Élect., Bull. 8. pp. 535–561, Aug.–Sept.–Oct., 1908.)—A description is given of G. Lippmann's method for determining the constant of an absolute electrodynamometer. The ordinary method of determining the constant is by calculation. Hence, in order that the results may be accurate, large single-layer coils are used which are very expensive to construct, and as the forces are small the moving part must be very light. In Lippmann's method these difficulties are obviated. The coil is wound on a stucco cylinder, the price of a marble one being regarded as prohibitive. Full descriptions of the experiments and photographs of the apparatus are given. The author uses his result to find the e.m.f. of a Weston cell. In his first experiment he obtains 1·01819 volts as the e.m.f. at 20·1° C., and in his second 1·01825. The standard manganin resistance used was calibrated by Jouaust. A. R.

132. *New Absolute Electrodynamometer and Determination of the E.M.F. of a Weston Cell.* **H. Pellat.** (Soc. Int. Élect., Bull. 8. pp. 573–638, Aug.–Sept.–Oct., 1908.)—This important paper gives a full description of a new absolute electrodynamometer designed by the author and constructed by Carpentier.

The theory and calculations are given in full, and special stress is laid on the *maximum possible error* that could be made in any experiment. The value of *g* at Paris found by recent experiments is 980·951. The author was able to measure the constant of the instrument with a max. inaccuracy of 1·6 in 10,000, and so the probable inaccuracy would be much smaller. He obtains the satisfactory result that the constant of the instrument is practically independent of the temperature. He applies it to determine the e.m.f. of the Weston cell in terms of the French value of the international ohm. He concludes that at 20° C. the e.m.f. of the Weston cell is—

$$1{\cdot}01841 \pm 0{\cdot}00015 \text{ volts.}$$

A. R.

133. *Absolute Electrodynamometer and E.M.F. of Cadmium Cell.* **P. Janet, F. Laporte, and R. Jouaust.** (Soc. Int. Élect., Bull. 8. pp. 459–522, Aug.–Sept.–Oct., 1908.)—The electrodynamometer is in the form of a current balance, a movable coil being supported from each end of the beam of a Curie balance. Coaxial with each moving coil, two fixed coils are supported on separate bobbins, the axial distance between these fixed coils being about 8 times the axial length of one of them. All the coils consist of many layers, but the dimensions necessary for the calculation of the force due to unit current could be determined with considerable accuracy. In terms of the ampere (10^{-1} C.G.S.), as realised by the electrodynamometer, and the international ohm, the value of the e.m.f. of the cadmium cell was determined as 1·01869 volts at 20° C. However, there appears to be some slight uncertainty about the value of the resistances used, and this part of the research is dealt with in an appendix. At the National Bureau of Standards Guthe found the e.m.f. of the cadmium cell to be 1·0185 volts at 20° C. [see Abstract No. 1904 (1906)], and Ayrton, Mather, and Smith [see Abstract No. 469 (1908)] gave the value 1·0188 volts at 17° C. or 1·0182 at 20° C. F. E. S.

134. *Reproducibility of Cadmium Cells.* **P. I. Wold.** (Phys. Rev. 27. pp. 329–334, Oct., 1908.)—In 1905-6 a number of cadmium cells were set up with a depolariser common to all. In some of the cells chemically purified mercury was used, and in the remainder the mercury had been distilled. The e.m.f.'s of the cells set up with the chemically purified mercury were initially low, and as time went on they gradually increased, but even after 6 months the mean e.m.f. was about 6 parts in 100,000 lower than the mean e.m.f. of the cells containing distilled mercury. In 1906-7 20 more cells were set up, triple-distilled mercury being used in all: the depolariser was prepared electrolytically. After 12 months one of these cells had fallen considerably in e.m.f., two were about 15 parts in 100,000 lower than normal, and the rest had e.m.f.'s differing from the mean by 1 to 6 parts in 100,000. The author concludes that cells set up at different places should agree in e.m.f. within a few parts in 100,000. F. E. S.

135. *Standard Cadmium Cell.* **P. Janet and R. Jouaust.** (Soc. Int. Élect., Bull. 8. pp. 409–458, Aug.–Sept.–Oct., 1908. Centralblatt Accumulatoren, 9. pp. 177–178, Dec. 5, 1908. Abstract.)—The authors have set up a considerable number of cadmium cells, and have used three kinds of mercurous sulphate. One of these was prepared electrolytically in accordance with the instructions given by Carhart and Hulett, and by Wolff; another sample was prepared electrolytically by the employment of an alternating current, and the third sample was chemically precipitated, the procedure

adopted by Smith being followed. The first batch of cells was made in June, 1906, and contain mercurous sulphate prepared by the first of the above methods. The e.m.f. of these cells has varied considerably, and in Aug., 1908, the mean e.m.f. was lower than the mean e.m.f. in June, 1906, by over 50 parts in 100,000. In June, 1907, some cells containing chemically precipitated mercurous sulphate were set up and by Aug., 1908, their mean e.m.f. had fallen by about 7 parts in 100,000. A third batch similarly prepared was set up in March, 1908, and the mean e.m.f. rose by 14 parts in 100,000 by the following August. The cells set up with depolariser prepared by the second method were made in May, 1908, and the observations so far made give little information as to the constancy of these cells. The authors have compared their cells with others from the Bureau of Standards and the National Physical Laboratory. From June, 1907, to Aug., 1908, two cells of the Bureau of Standards appear to have kept constant within 8 parts in 100,000, and in the same period 9 cells from the National Physical Laboratory remained equally constant, and 1 other varied by about 1 part in 10,000. The results obtained with cells made by the European Weston Co., the Cambridge Scientific Instrument Co., and by Carpentier are also given, and on the whole show the e.m.f. of the cell to be slightly variable with time. F. E. S.

136. *Equilibria in Standard Cells.* **G. A. Hulett.** (Phys. Rev. 27 pp. 337–366, Nov., 1908.)—The author has shown in a previous paper [see Abstract, No. 1682 (1907)] that there is a decided change in the e.m.f. of the cadmium cell when the kathode system is rotated. Indirect evidence was also obtained to show that the observed change was in no way due to surface tension. In the present paper it is shown that the mercurous sulphate is hydrolysed by the cadmium sulphate solution with the formation of a basic salt and an acid solution, the reaction proceeding until a certain acid concentration is established. When acid was added to the cadmium sulphate solution the e.m.f. of the cell changed but very little, and came to a constant value soon after the rotation of the kathode system was commenced. It was found possible to determine the mercury quantitatively in the kathode solutions, and a complete analysis of such solutions was therefore made, together with the density, concentration, and p.d. against mercury. These determinations were also made on systems to which known amounts of sulphuric acid were added, and from the results the solubility curve of mercurous sulphate as a function of the sulphuric acid concentration in the system was determined, and indicates the hydrolysis of mercurous sulphate in a cadmium sulphate solution. The basic salt which forms on hydrolysis is believed to suffer further hydrolysis to mercurous oxide and acid, and the formation of basic mercur*ic* sulphate may also result. The latter salt is a bright yellow compound, and its formation in a cell of falling e.m.f. has been previously observed. In a similar investigation on the kathode system of the Clark cell no such hydrolysis of the mercurous sulphate was detected. F. E. S.

137. *Electrochemical Equivalent of Silver.* **P. Janet, F. Laporte,** and **P. de la Gorce.** (Soc. Int. Élect., Bull, 8. pp. 523–588, Aug.-Sept.-Oct., 1908.)—The voltameter used was of a large type, and in each experiment about 8 gm. of silver were deposited. The current was about 0·5 amp., and the electrolyte consisted of a 15 per cent. solution of silver nitrate in water. The current was measured by means of a resistance and a cadmium cell which had been previously standardised by an absolute electrodynamometer at the Laboratoire central d'Électricité [see Abstract No. 138 (1909)]. Particulars

are given of six experiments, and the values obtained for the electrochemical equivalent of silver are 1·11820, 1·11828, 1·11811, 1·11821, 1·11826, and 1·11824 mgm. per coulomb. The mean value is 1·11821, and differs by only 6 parts in 100,000 from the value 1·11827 given by Smith, Mather, and Lowry [see Abstract No. 868 (1908)]. Photographs of a few deposits, some of which show striations, accompany the paper. F. E. S.

138. *Construction of International Ohms.* **J. R. Benoit.** (Soc. Int. Élect., Bull. 8. pp. 568–572, Aug.–Sept.–Oct., 1908.)—A description of the methods employed in choosing and determining the constants of ten glass tubes to serve as mercury standards of resistance. The tubes are of *verre dur*, and the correction factor due to the conicality of a tube has been determined by an elaborate calibration with very great accuracy. For the determination of the mass of mercury contained by a tube, threads of mercury, nearly filling the tube, were introduced. Their lengths and masses were determined, and, by using the calibration data, the mass completely filling the tube was calculated. The error introduced owing to inexact knowledge of the shape of the menisci terminating a mercury thread was certainly small, and was rendered negligibly so by using a large number of threads in slightly different positions of the tube. With the exception of one standard, the lengths of the tubes are such that at 0° C. a mercury column contained by one of the tubes has a resistance equal to 1 international ohm, within 5 parts in 100,000. F. E. S.

139. *Influence of Humidity on Manganin Resistances.* **St. Lindeck.** (Electrician, 62. pp. 351–352, Dec. 11, 1908.)—Referring to a previous communication [see Abstract No. 1678 (1908)], the author believes that confusion may have arisen. The behaviour of *standard resistances* should be kept separate from the behaviour of *test coils* intentionally submitted to conditions that would not be met with in any climate. In *standard resistances* the author has observed the following maximum variations in the interval April, 1907–April, 1908 :—

Value.	Designation.	Variation per cent.	Value.	Designation.	Variation per cent.
1 ohm	1 A	$0{\cdot}001_5$	1,000 ohms......	1,000 A	$0{\cdot}007_4$
10 ohms......	10 A	$0{\cdot}008_1$	1,000 „	1,000 B	$0{\cdot}006_5$
10 „	10 B	$0{\cdot}002_6$	1,000 „	1,000 C	$0{\cdot}007_7$
100 „	100 A	$0{\cdot}008_5$	10,000 „	10,000 A	$0{\cdot}006_1$
100 „	100 B	$0{\cdot}008_5$	10,000 „	10,000 B	$0{\cdot}005_5$
			10,000 „	10,000 C	$0{\cdot}007_1$

In conclusion, the author expresses his conviction that properly constructed manganin standards of resistance are by far superior to all others. F. E. S.

140. *Electromagnetic Tuning-forks.* **A. G. Rossi.** (N. Cimento, 16. pp. 97–121, July–Aug., 1908.)—Investigates the best conditions under which energy is supplied to an electromagnetically driven tuning-fork. In order to maintain the vibration, the magnetic attraction must not pass again through the same value when the amplitude reaches the same value in the advancing or retreating half-period. Otherwise the area of energy supplied becomes two coincident lines. As regards the contact, the author points out that a graduated contact is preferable to one which is abruptly made or broken. Such a gradual contact is furnished by most patterns of carbon microphones, such as those of Mix and Genest. He mounts one of these between the prongs of a tuning-fork. Its resistance varies between 10 and 100 ohms, and it can carry as much as 0·2 amp. for a quarter of an hour. It is essential that the force should be a quarter-period in advance of the deflection. E. E. F.

141. *Compass of Large Magnetic Moment.* **L. Dunoyer.** (Comptes Rendus, 147. pp. 884–887, Nov. 9, 1908.)—The use of compasses of large magnetic moment is desirable where they are for use in weak magnetic fields. The compensation of such compasses is attended with some difficulty, and the question has been recently raised on account of the adoption in the Italian Navy of the Magnaghi compass (magnetic moment 8,200 c.g.s. units) as the standard pattern. The numerical table which serves for the compensation of this compass is based on an elementary approximate theory which makes use of hypotheses not easily justifiable. In the present paper the author deals with the reaction between the compass and the soft-iron compensators, and shows that the mutual action of the compensating sphere and the compass is equivalent, as regards the deflections of the compass, to the existence of a uniform field equivalent to the projection on the line joining the centre of the compass and the centre of the sphere, of a constant vector directed along the magnetic axis of the compass needle. An expression is obtained for this vector, and experiments showed that the theory was, within the limits of error, correct. A. W.

ALTERNATING CURRENTS AND MAGNETISM.

142. *Orientation of Crystals by the Magnetic Field. Importance of the Optical Properties of Mixed Liquids from the point of view of Crystalline Symmetry.* **A. Cotton** and **H. Mouton.** (Comptes Rendus, 147. pp. 51–53, July 6, 1908.)—Contrary to Meslin's view [Abstract No. 1860 (1908)], the authors contend that we should still adhere to the conclusions held since Faraday's time, viz., that in a uniform magnetic field the orientation of a crystalline fragment does not depend either on its form or on the medium which surrounds it, the magnetic metals and their salts being excluded. The magnetic properties of a crystal may be represented by an ellipsoid. The electrical and the optical properties may be similarly represented. Although the relationship between these three ellipsoids cannot be generally stated, the elements of symmetry of the crystal belong to all three. D. H. J.

143. *Hysteresis in certain Iron Compounds.* **G. Berndt.** (Phys. Zeitschr. 9. pp. 750–752, Nov. 1, 1908. Paper read before the 80. Naturforscherversamml., Köln. Ann. d. Physik, 27. 4. pp. 712–734, Nov. 26, 1908.)—The following compounds were examined: Ferric oxide; ferric hydroxide, obtained by gradual oxidation of the carbonate, and hence containing carbonate and oxide; ferric chloride; ferrous and ferric sulphates. Ferric oxide and hydroxide exhibit marked hysteresis and residual magnetism, which are not observed with the other compounds used. With ferric oxide the susceptibility decreases at a diminishing rate as the strength of field increases; with ferric hydroxide it increases to a maximum and then diminishes as the strength of field is raised. T. H. P.

144. *Magnetism of Rare Earths.* **B. Urbain** and **G. Jantsch.** (Comptes Rendus, 147. pp. 1286–1288, Dec. 14, 1908.)—The substantial difference between the magnetic susceptibilities of the oxides of successive metals of

the rare earths group is pointed out. The estimation of mixtures is much simpler by the magnetic method than by the determination of mean atomic weight, particularly in view of the smallness of the differences between atomic weights in the series. The following figures for susceptibility $k \times 10^6$, are for the oxides R_2O_3, $k \times 10^6$ for $CoSO_4 . 7H_2O$ being taken as 89·7 :—

	Neodymium.	Samarium.	Europium.	Gadolinium.	Terbium.	Dysprosium.
Atomic weight	144·3	150·4	152	157·3	159·2	162·5
$k \times 10^6$	88·5	6·5	88·5	161	287	290

There are two maxima in the rare earths, one in the cerium group and another in the yttrium group. Lanthanum is diamagnetic, praseodymium paramagnetic. The susceptibility of holmium is certainly very high, and the coefficients of erbium, thulium, neo-ytterbium, and lutecium are successively lower. It is pointed out that bismuth, by the isomorphism of its salts with those of the rare earth metals of the same type, falls between the end element (samarium) of the cerium series and the first (europium) of the yttrium series. F. R.

145. *Increase of Resistance by Skin Effect.* **F. Rusch.** (Elektrotechn. Zeitschr. 29. pp. 1079–1081, Nov. 5, 1908.)—Starting from first principles, differential equations are developed expressing the current-density and flux-density at any distance from the axis of a straight cylindrical conductor. Expressions are then deduced for its resistance to alternating currents and its co-efficient of self-induction. The case of a cylindrical solenoid is next considered, and the differential equations are shown to be of similar form with those of the preceding case, but with flux-density and current-density interchanged; by this means the original solutions are used to obtain expressions for the resistance and coefficient of self-induction in the latter case. J. D. C.

REFERENCES.

146. *Positive Rays.* **W. Wien.** (Phys. Zeitschr. 9. pp. 765–767; Discussion, p. 767, Nov. 1, 1908. Paper read before the 80. Naturforscherversamml., Köln.)—Describes experiments dealing with the effect of a magnetic field on canal rays. From his researches the author concludes that the small part of the canal rays little influenced by a magnetic field is the principal cause of the emission of light. A. W.

147. *Propagation of Waves from a Hertzian Vibrator, immersed in a Conducting Medium.* **A. Petrovskij.** (Acad. Sci. St. Pétersbourg, Bull. 16. pp. 1217–1223, Nov. 15, 1908.)—A mathematical paper. The propagation of electromagnetic waves from a Hertzian vibrator was investigated by Hertz and others, assuming that the medium surrounding the vibrator is an ideal insulator. Starting from the general equation for an electromagnetic field, the author deduces equations for the propagation of waves from a vibrator placed in a conducting medium. T. H. P.

148. *Corpuscular Theory of Thermo-electric Forces.* **J. Kunz.** (Phil. Mag. 16. pp. 767–789, Nov., 1908.)—A mathematical discussion of the theory of thermo-electric phenomena based on the theory of metallic conduction developed by Lorentz, J. J. Thomson, and others, according to which the currents of electricity and heat are carried by negatively charged particles, diffused like a very light gas throughout the metal, having a mean free path and a mean velocity, and exerting a definite pressure. J. J. S.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

149. *Extraction of Rare Gases from the Atmosphere.* **G. Claude.** (Comptes Rendus, 147. pp. 624–627, Oct. 12, 1908.)—The apparatus previously described [see Abstracts Nos. 404, 1201 (1904); 594 (1906)] renders possible the ready extraction of neon and helium from the air. By its means the author has obtained 1–2 parts of gas having the density 0·68 (air = 1) from 100,000 of air, a proportion equal to that found by Ramsay for the neon (density, 0·69) in the atmosphere. T. H. P.

150. *Treatment of Pitchblende Residue.* **L. Haitinger and K. Ulrich.** (Akad. Wiss. Wien, Sitz. Ber. 117. 2a. pp. 619–630, May, 1908.)—The authors describe in detail the working up of the radio-active residue (10,000 kg.) from 30,000 kg. of pitchblende containing 58·4 per cent. U_3O_8. The operations lasted two years, and yielded a total weight of radium corresponding with 3·286 gm. of anhydrous radium chloride of activity 27·2 × 10^6. They call attention to the fact that radium bromide loses bromine on keeping, which is not generally known. T. H. P.

151. *Lithium in Radio-active Minerals.* **W. N. Hartley.** (Chem. News, 98. pp. 151–152, Sept. 25, 1908. Paper read before the British Assoc. at Dublin.)—The author traverses the statement of Ramsay (Nature, p. 412, March 5, 1908) that sodium and potassium are much more widely distributed than lithium, as spectroscopic examination of various waters, minerals, ashes of wood and cereals, and the blood and muscle of ruminant animals and of man shows this element to be very widespread although in small amounts. Further, there does not appear to be any connection between lithium and the radio-active elements. T. H. P.

152. *Action of Radium Emanation upon Water.* **E. Rutherford and T. Royds.** (Phil. Mag. 16. pp. 812–818, Nov., 1908.)—Referring to the experiments of Cameron and Ramsay [Abstract No. 1318 (1908)], in which they considered that the transformation of the radium emanation into neon had been proved, the authors of this paper have carried out experiments to test whether the neon which was present in the investigation mentioned could have been derived from the air. Preliminary experiments were made to determine the amount of neon which could be detected spectroscopically, and it was found that when 1/15 c.cm. of air was introduced into the apparatus the neon yellow line could easily be detected. As, according to the measurements of Ramsay, neon is present in air in about one part in 100,000 by volume, the presence of neon in amount less than one-millionth c.cm. can thus be readily detected. The gases formed by the action of radium emanation on water were next collected and tested, but no trace of the neon spectrum was observed. The spectrum of helium was complete and brilliant. In five successive experiments the presence of neon was observed once, but in this case there was evidence that its appearance was due to a leak of air into the apparatus. It was proved that the presence of helium in the discharge tube did not interfere with the detection of a small quantity of neon. No trace of neon was found in the gases produced in the water solution of the radium salt from which the emanation is pumped off. The authors think that the neon spectrum observed by Cameron and Ramsay was due to leakage of air into their apparatus, and consider that the experiment described by them is quite inadequate as a proof of the production of neon from the emanation. The delicacy of the spectroscopic detection of neon in small quantities of air seems not to have been understood.

J. J. S.

153. *Apparent Decay of Radium.* **W. Ramsay.** (Nature, 79. p. 129, Dec. 3, 1908.)—A sample of radium bromide sealed up in a bulb with water was found to give a regular evolution of about 30 c.cm. of electrolytic gas per week for about 9 months, after which time the gas formed diminished almost to nothing, and, after explosion, was found to leave about half its volume of excess hydrogen. The author suggests the following alternative explanations of this behaviour: (1) The radium bromide, of which the apparatus contains 0·5071 gm., implying 0·2716 gm. of metallic radium, has practically ceased to decompose water, or (2) the velocity of the reverse action, viz., the combination of oxygen and hydrogen to form water, has increased to such an extent as to reverse the decomposition. It may be that the evolution of heat or the emission of "rays" by radium is similarly affected by time. T. H. P.

154. *Preparation of Urano-uranic Oxide, U_3O_8, and a Standard of Radioactivity.* **H. N. McCoy** and **G. C. Ashman.** (Amer. Journ. Sci. 26. pp. 521–530, Dec., 1908.)—The authors show that uranium is easily freed from all other radio-active substances, and that pure U_3O_8 is readily obtained by heating any lower or higher oxide of uranium in air at 700°. Uniform films of U_3O_8 [compare Abstracts Nos. 1222 (1905), 715, 1578 (1906)] 7 cm. in diam. and weighing 0·6–0·8 gm., have definite and constant α-ray activity, and are, therefore, recommended as standards of radio-activity. The α-ray saturation current for such a standard film was measured in absolute units, and from these results the total ionisation current for 1 gm. of uranium, in an infinitely thin film, was calculated to be $4{\cdot}61 \times 10^{-10}$ amp. The α-ray activity of radium, free from its products, is found to be $1{\cdot}29 \times 10^{6}$ times that of an equal weight of uranium, a result which is in good agreement with that obtained by Boltwood [Abstract No. 1100 (1908)]. T. H. P.

155. *Viscosity of Liquid Sulphur.* **L. Rotinjanz.** (Zeitschr. Phys. Chem. 62. 5. pp. 609–621, April 28, 1908.)—A series of viscosity curves ranging over temperatures from 120° to 448° was determined for pure sulphur, for sulphur containing iodine, and for sulphur through which a stream of ammonia had been passed. The absolute values of the viscosities and also the position of the maxima vary according to the preliminary heating of the sulphur. For example, sulphur previously heated to 187° showed a maximum viscosity at 187°; if the sulphur was previously heated to 448° the max. viscosity was at 210°, and the viscosity curve was much lower. The effect of iodine or treatment with ammonia is very great; in one case an addition of 0·77 per cent. of iodine reduced the viscosity 173 times. There is no connection between the viscosity and the percentage of sulphur insoluble in CS_2.

D. H. J.

156. *Kinetics of the Change in Molten Sulphur and Latent Heat of Fusion of Monoclinic Sulphur.* **A. Wigand.** (Zeitschr. Phys. Chem. 63. 3. pp. 273–306, June 30, 1908.)—Investigations have shown that molten sulphur consists of a mixture of two modifications, and Tammann has shown that there is a soluble and insoluble form of sulphur, and that the greater density of the latter together with its insolubility form ground for the hypothesis that there are a greater number of atoms in the molecule than in the molecule of the soluble variety. The insoluble modification has a molecular weight corresponding to S_6 and the soluble to S_8, as determined by the lowering of freezing-point and rise of boiling-point methods. Schaum has determined the change of melting-point of sulphur with the time of heating, and the author has used these results to calculate the mass-law constant of the reaction—

$$8\,S_{8\,\text{sol.}} \rightleftarrows 4\,S_{6\,\text{insol.}},$$

and gives a method of integrating the equation—

$$dx/dt = R(A - x)^8 - k^1(B + 4x/8)^4,$$

where A and B are the initial concentrations of the two varieties of sulphur present and x the amount of $S_{\text{sol.}}$ transformed in the time t. The value calculated for K′ was not a constant, indicating that the above assumption $8\,S_{8\,\text{sol.}} \rightleftarrows 4\,S_{6\,\text{insol.}}$ was not tenable in its simple form. A careful determination of the latent heat of fusion was made in a specially designed calorimeter, the temperature being measured by a resistance thermometer, and the value obtained was 10·4 per gm.-cals. per gm. of sulphur. The heat of transition $S_{\text{liquid sol.}} \longrightarrow S_{\text{liquid insol.}}$ was calculated from the equilibrium constant and found to be 21·1 gm.-cals. per gm. of sulphur. The explanation of the anomalous behaviour in liquid sulphur is that the reaction is an incomplete reaction of the first order, the change being a reversible isomeric transition $S_{\text{sol.}} \longrightarrow S_{\text{insol.}}$

The molecule of both insoluble and soluble sulphur is S_8, the change from $S_{\text{sol.}}$ to $S_{\text{insol.}}$ taking place without alteration of molecular weight. The equilibrium constant and the velocity constant were calculated to 140° C., and agreement found with the law of mass action for a unimolecular reaction. F. J. B.

157. *Thorium.* **W. v. Bolton.** (Zeitschr. Elektrochem. 14. pp. 768–770, Nov. 20, 1908.)—I. The Metal.—Metallic thorium is prepared by passing CCl_4 gas over thorium oxide in a combustion tube, the $ThCl_4$ so obtained being mixed with sodium shavings and reduced in an iron crucible at a red heat. The metal so reduced consists of a matted agglomeration of small crystals, and is converted into metallic ribbon by placing in a hollow copper rod, which is afterwards closed by a copper plug. The whole is then passed through a wire mill and drawn down to any desired gauge, finally being flattened in a sheet mill. The copper covering is dissolved off in nitric acid and a fine ribbon of Th is left. In colour, softness, and ductility the metal resembles Pt, and has a specific resistance of 0·401. KOH and HNO_3, even boiling, attack the metal very slowly. H_2SO_4 converts it gradually into sulphate. HCl attacks it rapidly, but leaves about 15 per cent. of an insoluble residue, which HNO_3 converts into a lemon-coloured substance. The sp. gr. found is 11·82 for the powder and 12·16 for the rolled ribbon. II. Muriaticum Thorium.—When the powder is treated with a 5 per cent. solution of HCl in the cold about 10 per cent. is dissolved, which, after filtration, is thrown out of solution by heating or by the addition of strong HCl; to this substance the above name is given. The substance is completely soluble in water. Although a chlorine compound, it gives only a faint

opalescence with $AgNO_3$. Reasons are adduced to show that it cannot be a meta-thorium oxychloride, but that it is analogous to the known nitric-thorium oxide $(ThO_2)_{10} (HNO_3)_4$; for $(THO_2)_{10} (HCl)_4$ would contain 5·08 per cent. Cl and 5·4 was obtained by analysis. Muriaticum thorium differs in a number of given reactions from those of $ThCl_4$, especially with oxalic and sulphuric acids, both of which precipitate the normal salt but leave the muriaticum unaffected. When heated in a stream of CCl_4 it is completely transformed into the normal chloride. No difference is found in the radio-activities of muriaticum and normal thorium. C. O. B.

158. *Overheating Phenomenon of Aluminium.* **W. v. Bolton.** (Zeitschr. Elektrochem. 14. pp. 766–767, Nov. 20, 1908.)—When an Al wire is heated in a Bunsen flame, it is fused without breaking; it is covered with a skin of oxide which prevents the metal fusing into drops. Inside the tube of oxide thus formed the metal is retained in the fluid state. The same phenomenon can also be obtained by the passage of an electric current, and by this means higher temperatures can be obtained without disruption or volatilisation of the metal. By passing a gradually increasing current through a wire 8 to 10 cm. long, made into a loop, it may be made to glow radiant white, showing a temperature of 1,600° C., although Al melts at about 657°; if left for several hours with this current passing, the metal finally bursts through with hissing and faint scintillation. The wire for the test should not be less than 0·1 mm. diam., that best suited being from 0·3 to 0·5 mm. By using a wire 0·5 mm., a current of 35 amps. may be passed for several hours so that the wire will remain a bright glowing white during the whole time. The durability is increased and the length of the glowing wire may be increased, if it be spirally wound round a rod or tube of magnesia. The experiments also succeed with magnalium, an alloy of Al and Mg. Other metals such as Mg, Zn, Cd, Cu, Ca, and Ta do not give the phenomenon, as all except Ta are more easily reducible than Al, and also they are more easily oxidised throughout, as the oxide coverings are more readily melted or volatilised. That in the experiments described, the Al is absolutely melted is proved, not only by the temperature far exceeding the melting-point of Al, but also by the mechanical deformability of the wire, which can be lifted up by means of an iron wire. Direct or alternating current may be used. C. O. B.

159. *The Preparation o, Alloys of Nitride-forming Metals.* **E. Beck.** (Metallurgie, 5. pp. 504–521, Sept. 8, 1908. Communication from the Inst. f. Metallhüttenw. u. Elektrometall. d. kgl. techn. Hochschule, Aachen.)—The author has unsuccessfully attempted to produce nitrides directly from oxides. Experiments to reduce the metals by means of carbon under introduction of nitrogen failed likewise; he obtained carbides but hardly any nitride. Nor did he succeed in converting one of the two alloyed metals, electrothermally reduced, into a nitride. He therefore prepares by electrolysis an alloy of two metals, of which one (Mg) is easily converted into a nitride, the other (Sn) not. He feeds the bath with MgO and decomposes the resulting nitride with steam so that the oxide (or hydroxide) is regained. He first tried iron cells, heated from outside and by the current, tin, a mixture of the fluorides of Na, K, Mg, and an anode of carbon. The tin attacks the iron, unless the latter is lined; the mixture has a high melting-point, and the reduced Mg rises in it and is burned. Mixtures of the fluorides of Mg and Ca answer better, especially when further mixed with carnallite ($MgCl_2 . NaCl . KCl$). These mixtures and the carnallite alone have lower melting-points, and the chlorine liberated does not attack the anode, while the oxygen from the oxides burns the anode. Technically carnallite and fluorides should answer. The electrolyte should be agitated, which might be facilitated by arranging several cells at different levels. Lead kathodes instead of tin kathodes would be simpler, but their yield is poorer. The author studies the eutectic curves, and calculates that his processes should technically be able to compete with the nitrogen-lime process of Frank and Caro. The crucibles or cells are described as being of the W. Borchers type. H. B.

160. *Conversion of Iron Pyrites into Magnetic Oxide in Electric Furnaces.* **O. L. Kowalke.** (Amer. Electrochem. Soc., Trans. 13. pp. 133–141, 1908.) —The author investigates the conditions favourable for the conversion of iron pyrites (in blende and other sulphides) into magnetic oxide suitable for extraction by magnetic separators. He places a tube of Meissen porcelain, 26 in. long, 1 in. internal diam., in a brick furnace packed with graphite, and wraps the tube outside with charred paper to prevent pitting of the porcelain by the hot resistor. Temperatures are measured with a le Chatelier thermocouple (standardised at the Reichsanstalt), and he experiments on marcasite in air and in various atmospheres of purified gases. It is not necessary to roast marcasite to a homogeneous mass; when from 3 to 12 per cent. of sulphur have been given off, the iron oxide is sufficiently magnetic, on the outside at any rate, to be picked out. When the roasting is carried out under reduced pressure or in a reducing atmosphere (H,CO), the magnetic oxide is formed at a lower temperature and under a smaller loss of sulphur. In a neutral atmosphere, S begins to distil from FeS_2 at 510° C.; the roasting may be stopped at 600°; above 680° FeS is formed. Marcasite can be reduced to iron in an atmosphere of hydrogen. H. B.

161. *Some Chromium and Manganese Alloys.* **G. Hindrichs.** (Zeitschr. Anorg. Chem. 59. 4. pp. 414–449, Sept. 7, 1908. Metallog. communication from the Inst. f. physikal. Chemie d. Univ., Göttingen.)—Gives results of thermal analyses of several alloys, the chief results of which are summarise in the following table:—

IMMISCIBLE.

Alloy.	In Liquid.	In Solid.	Compounds.
SnCr	0 — 87 Cr	0 — 95 Cr	None
PbCr	10 — 75 Cr	0 — 100 Cr	„
CuCr	2 — 98 Cr	0 — 100 Cr	„
AgCr	0 — 92 Cr	0 — 100 Cr	„
AlCr	0 — 86 Cr	0 — 85 Cr	$AlCr_3$(?)
AlMn	14 — 42 Mn	0 — 62 Mn	Al_3Mn(?) $AlMn_3$(?)
AgMn	< 2 — 87 Mn	0 — 100 Mn	None

C. O. B.

162. *Compounds of Silicon and Palladium.* **P. Lebeau and P. Jolibois.** (Comptes Rendus, 146. pp. 1028–1031, May 18, 1908.)—When Si and Pd are heated in a porcelain crucible, they combine at a temperature of 500° to 600° C. with an evolution of heat sufficient to bring the whole mass to fusion.

The temperature of fusion varies greatly with the relative amounts of the elements present. The melting-point of Pd is taken at 1,587°; with 6 per cent. Si, the first minimum is obtained corresponding to a eutectic at 670°. With 11·76 per cent. Si a maximum is obtained at 1,400°, corresponding to the compound $SiPd_2$. After this maximum the curve of fusibility falls to 750° in the 16 per cent. Si alloy. There are indications that a second compound SiPd occurs at 21 per cent. Si, and a second eutectic at 25 per cent. Si with a melting-point of 825°, after which the curve slowly rises to the melting-point of Si. A microscopic examination of the alloys confirms the deductions from the curves, the proportions corresponding to the compounds giving perfectly homogeneous bodies. The existence of the first compound, $SiPd_2$, can be proved by chemical separation, and the existence of the second is fairly certain, from the perfect agreement of the metallographic evidence. C. O. B.

163. *Antimony Trichloride as an Ionising Solvent.* **Z. Klemensiewicz.** (Acad. Sci. Cracovie, Bull. 6. pp. 485–494, June, 1908.)—The density of the chloride was 2·681 at 75° and 2·647 at 97°; the smallest observed conductivity was $8{\cdot}5 \times 10^{-7}$ reciprocal ohms per cm. cube—a value which corresponds with that of purified water and other similar solvents, but is altogether removed from those for ordinary fused salts. The solutes used in preparing conducting solutions were KCl, RbCl, NH_4Cl, TlCl, and $HgCl_2$; LiCl, NaCl, and KCl were found to be almost insoluble, as were also $CaCl_2$, $SrCl_2$, $BaCl_2$, $ZnCl_2$, $CdCl_2$, $PbCl_2$, CuCl, Hg_2Cl_2, and $AlCl_3$. The four soluble binary electrolytes gave solutions of high conductivity, up to 0·04 reciprocal ohms per $cm.^3$, and molecular conductivities at a dilution of 1,024 litres per equivalent amounting to 158·5, 156·5, 150·5, and 154·5 respectively, and thus considerably exceeding the corresponding values for aqueous solutions; the increased conductivity is due to greater ionic mobility and the coefficients of ionisation are probably smaller than in water; the exact values could not be determined as the limiting values for the molecular conductivity could not be reached and extrapolation could not be relied on to cover the wide gap between the highest observed values and those for infinitely dilute solutions. The temperature-coefficients of conductivity were positive, but decreased with rising temperature (as in the case of aqueous solutions of the acids between 0° and 100°); a maximum of conductivity was not reached even at temperatures above 200°. The viscosity and fluidity of the trichloride were found to be as follows :—

t	79·1	99·1	119·0	139·2	159·7	181·2	191·6
η	0·0241	0·01955	0·0148	0·0124	0·0108	0·0097	0·0091
$1/\eta$ ...	41·5	51·15	67·5	80·7	92·5	103·6	109·8

(water at 17° = 0·01081). The curve shows at 120° a point of inflection, which appears to be unique. T. M. L.

164. *Relation between Ionising Power and Dielectric Constants of Solvents.* **H. N. McCoy.** (Amer. Chem. Soc., Journ. 30. pp. 1074–1077, July, 1908.)—Walden has shown that in the case of tetraethylammonium iodide equal coefficients of ionisation are found in different solvents if $\epsilon V^{\frac{1}{3}} = f(\alpha) =$ constant for any given value of α, where ϵ is the dielectric constant and V the dilution. Kohlrausch has given for any one solute and solvent the equation, $\Delta = \Lambda_\infty - kC^{\frac{1}{2}}$; here Λ = molecular conductivity, C = concentration. This may be written $\Lambda/\Delta_\infty = 1 - kC^{\frac{1}{2}}/\Lambda_\infty$, $\alpha = 1 - KC^{\frac{1}{2}}$, or $K = (1-\alpha)V^{\frac{1}{2}}$. Combining with Walden's equation it follows that K_t = constant for a given solute in all solvents at all dilutions and for all coefficients of ionisation. Actually the values range in the case of Walden's iodide from 82·8 to 48·1 in a series of 13 solvents; for potassium iodide the values are: in water 88·0, alcohol 86·2, acetonitrite 51·9; for lithium nitrate in water 88·2, methyl alcohol 88·2, water plus methyl alcohol 86·8. T. M. L.

165. *Ionisation by Phosphorus and Phosphorescence.* **L. Bloch** and **E. Bloch.** (Comptes Rendus, 147. pp. 842–844, Nov. 9, 1908.)—During the passage of air over phosphorus, phosphorescence, ionisation, and formation of ozone occur in the same region, which may be at some distance from the phosphorus if the air current is sufficiently rapid. These phenomena are not due to direct oxidation of solid phosphorus or its vapour, but to oxidation of phosphorous anhydride, which is formed directly from phosphorus, and the dark zone which precedes phosphorescence would be where phosphorous anhydride is not yet converted into phosphoric anhydride, the change being a process of combustion. The mobility of the phosphorus ions reaches as much as 0·1 mm., and may be increased to some 2 or 3 mm. by placing a plug of cotton-wool after the phosphorus, which retains any fumes formed on the latter. W. H. Sl.

166. *Dissociation Pressures of Ferric Oxide.* **P. T. Walden.** (Amer. Chem. Soc., Journ. 30. pp. 1850–1855, Sept., 1908.)—The dissociation pressures of ferric oxide, Fe_2O_3 were found to be as follows:—

Temp.	1,100°	1,150°	1,206°	1,250°	1,300°	1,320°	1,340°	1,350°	1,360°	1,380°	1,390°	1,400° C.
Pres.	5·0	7·0	9·0	20·0	59·5	90·5	138·5	166·0	202·0	297·0	352·5	454·0 mm.

The temperature of dissociation in air ($p = 160$ mm.) is 1,350°; at this temperature the magnetic oxide, Fe_3O_4, produced no pressure that could be measured by the manometer. The pressures calculated by v. Jüptner (Theorie der Eisenhüttenprozesse, p. 9) by means of Nernst's formula are in this case very much greater than the observed values, *e.g.*, calc. for 1,327°, 13231·6 mm.; observed at 1,330°, 113·0 mm. T. M. L.

167. *Dissociation Pressures of Oxides of Copper, Cobalt, Nickel, and Antimony.* **H. W. Foote** and **E. K. Smith.** (Amer. Chem. Soc., Journ. 30. pp. 1844–1850, Sept., 1908.)—The dissociation pressure of cupric oxide $4CuO \rightleftarrows 2Cu_2O + O_2$ was found to be as follows—

Temp....	900°	950°	1,000°	1,010°	1,020°	1,030°	1,040°	1,050° C.
Press. ...	15·8	37·5	99	121	148	171	204	239 mm.

Cuprous oxide at 1,020° gave a pressure less than 1 mm. Taking the pressure of oxygen in the air as 160 mm., cupric oxide would become unstable at 1,025°; a mixture of cupric and cuprous oxides melts at 1,070°, so that the solid cuprous oxide first produced would only be stable between 1,025° and 1,070°. For the oxide Co_3O_4 the dissociation pressures were—

Temp....	800°	850°	900°	910°	950°	970° C.
Press. ...	10	28	144	188	521	765 mm.,

the temperature of dissociation in air being 905° C. The resulting monoxide CoO gave no permanent pressure when heated at 1,100°, and on analysis gave perfectly normal figures; the statement of Richards and Baxter (Chem. News,

81. p. 125, 1900) that the oxide dissociates at 800° into cobalt and oxygen is therefore erroneous. The higher oxide of nickel was found to be completely dissociated at 450°; for the monoxide NiO the dissociation pressures were—

Temp. ...	800°	900°	1,000°	1,100°	1,200°	1,245° C.
Press. ...	0·0	0·0	2·0	5·5	18·0	18·0 mm.

Further heating was prevented by the softening of the porcelain tube. The dissociation pressures of antimony tetroxide could not be determined accurately owing to sublimation of the trioxide, but the temperature of dissociation in air was found (by "weighing" experiments) to be 950°. It is interesting to note that the pressures calculated by Stahl [Abstract No. 2121 (1907)] from a formula of Nernst are totally different from those actually observed, *e.g.*—

CuO	927°	0·020 (calc.)	22 (found)
CuO	1,027°	0·22 (calc.)	150 (found)
NiO	1,127°	0·000000033 (calc.)	7 (found)
NiO	1,227°	0·00000066 (calc.)	15 (found)

For 227° the calculated pressure of NiO was $1{\cdot}859 \times 10^{-45}$ atmos., whereas *a single molecule of oxygen* in a volume of 22·4 litres would give a pressure of $4{\cdot}1 \times 10^{-24}$ atmos., *i.e.*, 2×10^{21} times greater than the calculated value. The discrepancies recorded in the table afford clear evidence that the calculated dissociation pressures have only a speculative value. T. M. L.

168. *Determination of Hydration of Ions by Measurement of Electromotive Force.* **G. N. Lewis.** (Zeitschr. Elektrochem. 14. pp. 509–510, Aug. 21, 1908. Contribution from the Research Lab. of Physical Chem., Mass. Inst. of Technology, No. 35. Amer. Chem. Soc., Journ. 30. pp. 1355–1357, Sept., 1908.)—Nernst's formula for concentration elements only holds when no transport of water of hydration occurs during the passage of the current. When such transport occurs, the formula becomes—

$$E = 2l_c \mathrm{RT/F}\,.\,\log(c_1/c_2) + n'\mathrm{RT/F}\,.\,\log(\xi_1'/\xi_2'),$$

where n' represents the number of mols. of water passing from the first solution, where its activity is ξ_1', to the second, where its activity is ξ_2', while an equivalent of electricity passes. The validity of this formula could be tested, for example, by an element with two thallium electrodes, one immersed in saturated aqueous thallous chloride, and the other in a saturated solution of thallous chloride, in a sugar solution, or in a solution of any other suitable non-electrolyte not transported by the current. T. H. P.

169. *Determination of Hydration of Ions by Transference Experiments in the Presence of a Non-electrolyte.* **E. W. Washburn.** (Technology Quarterly, 21. pp. 288–320, Sept., 1908. Contribution from the Research Lab. of Phys. Chem.)—The electrolysis of a solution of potassium, sodium, or lithium chloride, containing a non-electrolyte at low concentration, is attended by an increase in the ratio of the quantity of non-electrolyte to that of the water at the anode and by a corresponding decrease at the kathode, but no change takes place in this ratio in the absence of the salt. The change is to be attributed mainly, if not wholly, to a transfer of water from the anode to the kathode during the electrolysis. By referring the changes in the content of water and of salt to the non-electrolyte as a reference-

substance, a relation between the degrees of hydration of the Cl-ion, the Li-ion, Na-ion, and K-ion can be derived. A similar relation involving the hydrogen-ion has been previously obtained by Buchböck. The results show that all these kathions are hydrated; the hydration increases markedly between each two members of the series H^+, K^+, Na^+, Li^+, the *smallest* values of the hydration consistent with the data being those represented by the formulæ: $[\mathrm{H(H_2O)_{0\cdot3}}]^+$, $[\mathrm{K(H_2O)_{1\cdot3}}]^+$, $[\mathrm{Na(H_2O)_{2\cdot0}}]^+$, and $[\mathrm{Li(H_2O)_{4\cdot7}}]^+$. The fact that the ions of the elements of a group of the periodic system increase in migration velocity with increasing atomic weight has been explained by assuming that the ions of the lighter elements are more highly hydrated; the correctness of this explanation is demonstrated by the results now recorded. Owing to the transfer of water during electrolysis, the transference numbers hitherto obtained for concentrated solutions of the chlorides are somewhat erroneous, since the calculation involved the assumption that the water remained stationary. The true transfer-numbers vary with the concentration much less than the apparent ones previously computed, and in the case of KCl there is no variation whatever up to a concentration of 1·2 molar. It is pointed out that the method of moving boundaries gives the true transfer-number, and that the results of Denison and Steele obtained by this method agree closely with the numbers obtained in the present investigation. T. M. L.

170. *Difference of Potential between Electrode and Electrolyte.* **N. A. Gezechus [Hesehus].** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 40. pp. 209–211 [Physical Part], 1908.)—The results obtained by Pellat [Abstract No. 1547 (1908)], who found that mercury in contact with saturated mercuric chloride solution has a potential 0·0017 volt lower than that of the liquid whilst in N/1000 solution the potential of the metal is 0·0180 volt higher than that of the liquid, are in complete contradiction with Nernst's theory of the voltaic cell. The author explains these results as follows: (1) Of two chemically similar bodies in contact, the one with the greater superficial density, *i.e.*, the greater number of molecules per unit surface, becomes positively electrified. (2) When the superficial densities of the two bodies in contact are equal, the one having the greater capacity of dissociation becomes positively electrified. Combination of (1) and (2) gives the formula, $U_1 - U_2 = A(\delta_1 d_1 - \delta_2 d_2)$. The negative sign of Pellat's results corresponds to the condition $\delta_1 d_1 < \delta_2 d_2$. As the surface density of the electrolyte (d_2) is less than that of the electrode (d_1), δ_2 should be greater than δ_1, as should be expected, dilution increasing the dissociation. For very dilute solutions, d_2 becomes very small and the dissociation ceases to increase; so that $\delta_1 d_1$ becomes equal to, and ultimately greater than $\delta_2 d_2$, and U_1 greater than U_2, *i.e.*, the potential of the electrode will become +. T. H. P.

171. *Polarisation of Leaves and Thin Plates of Gold.* **G. Ercolini.** (N. Cimento, 16. pp. 298–314, Oct., 1908.)—Experiments with voltameters of sulphuric acid with gold electrodes of varying forms and dimensions show that, as in the case of mercury electrodes, the initial capacity depends not only on the surface of the electrodes, but also on their volume. The initial capacity increases with the area of surface of the electrodes, and, of two voltameters having electrodes of equal surface but different volumes, the one with the larger volume has at first the greater capacity, though after a short time the capacities become equal, and finally the one with the smaller volume has the greater capacity. The results may be explained by assuming a penetration of the ions into the interior of the electrodes, where they lose their charge and exert a depolarising action. A novel form of apparatus is described for enabling the voltameters to be charged for very short periods of time with great precision. W. H. St.

172. *Potential Curves in Iodine-Potassium Iodide Solutions. Experiments with Smooth Platinum.* **E. Brunner.** (Zeitschr. Phys. Chem. 63. 4. pp. 487–506, July 21, 1908.)—A continuation to the researches noticed in Abstracts Nos. 1949 (1906) and 768 (1907), concerning parallel tests of electrodes of smooth and of platinised Pt. The author had stated that anode and kathode may more or less coincide in space, and speaks of the anodic end of an electrode. On the whole the polarisations are slightly greater with smooth Pt than with platinised Pt, sometimes smaller, however. The differences in the potentials amount to a few millivolts only. The same formula applies for both types if another coefficient is introduced for smooth Pt, and the anodic end of an electrode does not show any systematic distinctions. The differences might be explained by any cause which produces sufficient differences in the current density and polarisation between different portions of an electrode. The author ascribes the typical differences to something which covers a portion of the electrode surface, and which acts like a resistance conducting metallically; kathodic polarisation quickly diminishes this resistance. There is no real supertension, based upon chemical polarisation. H. B.

173. *E.M.F. of Iodine Concentration Cells in Water and Alcohol.* **A. P. Laurie.** (Roy. Soc. Edinburgh, Proc. 28. pp. 382–393, 1908.)—The e.m.f. of iodine concentration cells in water and alcohol was measured. The cells consisted of Pt wires dipping into varying strengths of iodine dissolved in potassium iodide. It was found that both in water and alcohol solutions the Nernst law was obeyed, and that the e.m.f. of the cell was nearly proportional to the iodine added, when the KI was in large excess. The measured values agreed closely with those calculated from the Nernst formula. The agreement is not so satisfactory when the concentration of the iodine on one side is sensibly the same as that of the KI. The measurements were made at 20·4° C. and at 25°. Measurements of iodine in alcohol and water cells at 0° C. and 25° C. gave a large value for the temperature-coefficient of the e.m.f. of the cell, 0·025 KI + 0·001 I_2 in water ‖ 0·025 KI + 0·001 I_2 in alcohol was 0·1897 volt at 0° and 0·1988 volt at 25°. F. J. B.

174. *The Heriot Primary Voltaic Cell.* **J. Strachan.** (Chem. News, 98. pp. 102–104, Aug. 28, 1908.)—The cell was devised by the author eight years ago and set up in the George Heriot Hospital, of Ballyclare, Co. Antrim. It is a cell of the Daniell type, consisting of Zn [or Fe] in ($NH_4Cl + ZnCl_2 + HCl$) [or $NH_4Cl + ZnCl_2 + Fe_2Cl_6$], carbon, and $PbCl_4$ in HCl as a depolariser. The lead tetrachloride is the novelty. It cannot be obtained commercially, and can be produced either by passing Cl through suspended, freshly-prepared, $PbCl_2$, or by dissolving PbO_2 in cold concentrated HCl; the latter process is simpler, but disagreeable and even dangerous owing to the evolution of chlorine. When the PbO_2 is freshly prepared, however, it dissolves easily in HCl. The PbO_2 is gained from lead acetate and calcium hypochlorite, with cold strong solutions; PbO falls out first, becomes oxidised, and is stirred into cold HCl, in which it dissolves to a liquor of bright orange-yellow colour. Another method is also described. The $PbCl_4$ is decomposed by sunlight into $PbCl_2$, 2HCl and O, and rapidly decomposed also by organic substances, which it oxidises. The constant e.m.f. of the Zn/C cell is 1·5, that of the Fe/C cell 0·95. They are made in stone jars with lead covers; the chlorine smell is a disadvantage. H. B.

175. *The Oxide Theory of the Oxygen Electrode.* **R. Lorenz.** (Zeitschr. Elektrochem. 14. pp. 781–783, Nov. 27, 1908. Communicated from the physikal. chem. and Elektrochem. Lab. of the eidgen. Polytechnik, Zürich.)—The conflicting results obtained from a study of the e.m.f. of gas cells have shown that the free energy cannot be determined either from breaks in the curve of potential-current strength alone, nor from the measurement of the e.m.f. of elements alone, nor from the agreement of these two. As the varying results obtained for the hydrogen-oxygen cell appear to be due to irregularities at the oxygen electrode (oxidation, formation of H_2O_2, ozone, &c.), the author has studied the question, and finds that silver, nickel, copper, iron, lead, and zinc, when used as oxygen electrodes, give the same values for the e.m.f. as their oxides or hydroxides. Only in the case of Pt and some other noble metals was the proof of this imperfect. The method which the author employed was to determine the polarisation discharge curve, using a voltmeter of high resistance so as to get the effect due only to the reaction on the electrode and not that due to changes beside the electrode, such as concentration changes, &c. As a result it was found that the polarisation discharge curves (potential plotted against time) are of the same general form as in the case of fused electrolytes. With repeated charge and discharge different arrest-points appear, pointing to the fact that several processes occur at one and the same electrode. A. F.

176. *Action of the Silent Discharge on Moist Nitrogen and Nitric Oxide.* **W. Löb.** (Zeitschr. Elektrochem. 14. pp. 556–558, Aug. 28, 1908. Paper read before the 15. Hauptversamml. d. Deutsch. Bunsen-Gesell.)—In his continued researches [compare Abstract No. 1149 (1906)] the author uses higher tension, 220 or 110 volts, and by preference the Rotax current interrupter of the Elektrizitäts-Gesell. Sanitas of Berlin. In the presence of moisture the silent discharge transforms nitrogen chiefly into nitrous acid and also ammonia; nitric acid is not formed: the water vapour is evidently decomposed, traces of hydrogen being observed. The yield of ammonia increases when free hydrogen is added; this yield is always small, yet probably characteristic for the synthesis of organic substances. Nitric oxide at once yields brown vapour, when exposed to the discharge in the presence of moisture, under strong contraction; the gas then turns colourless without further contraction. The products are nitric and nitrous acids and their ammonium salts, the residue consisting of N; NO, N_2O, O_2 are not found finally. H. B.

177. *The Formation of Nitric Oxide in the High-tension Arc.* **F. Haber** and **A. Koenig.** (Zeitschr. Elektrochem. 14. pp. 689–695, Oct. 9, 1908. From the Inst. f. physikal. Chemie u. Elektrochemie d. techn. Hochschule, Karlsruhe.)—The combustion of nitrogen may be conducted as a purely thermal process. But this is not advisable; very high temperatures should be avoided, and the electrical effects favoured. The thermal equilibrium K_t between the three gases N, O, NO depends only on the temperature and the mass action; the electrical equilibrium K_e further requires the expenditure of a certain amount of electrical energy. K_e may be smaller or greater than K_t.

The former will be the case if the ionic collisions favour the formation of NO, as the authors assume; the latter if the collisions favour the decomposition of NO into N and O, as is generally believed. The authors work in a temperature range at which the velocity of the spontaneous splitting up of the NO formed is still small. Their experiments are conducted as before [see Abstract No. 185 (1908)], but they fit the Nernst glower into a hole drilled into the head of the iron lead and cement it with glass. The gas is passed through the vertical tube at various rates. Experiments with some material of Welsbach mantles show that those particles, and therefore also the gases, are pushed to and fro by the alternating electric currents until they finally escape from the tube. For this reason it appears improbable that considerable portions of the gases should pass through the tube without participating in the reactions. The temperature in the tube did not exceed the melting-point of Pt by more than a few hundred degrees; a Pt wire stretched as horizontal diameter of a split ring of Pt pushed half-way down the tube did not melt as a rule. The authors conclude, moreover, from the experiments of Haber and Hodsman on the dissociation of CO_2 in burning mixtures of CO and O, that oxygen changes qualitatively at temperatures below 3,000° C. The gases applied are air, mixtures of about 50 per cent. of N and O, and NO gas (generated from copper and nitric acid), which also contains about 50 per cent. of N. Starting with the 50 per cent. mixture or with NO, the NO-yield was 14.5 per cent. in both cases. The NO-formation in the arc seems, at comparatively low temperature, to be electrical in character. H. B.

178. *Kathode Volatilisation of Metals in Rarefied Gases.* **V. Kohlschütter.** (Zeitschr. Elektrochem. 14. pp. 417–421, July 31, 1908.)—A continuation of the controversy referred to in Abstracts Nos. 1014 and 1527 (1908). Kohlschütter admits that it is advisable to arrange two tubes in series; the arrangement is inconvenient, however, when several gases are to be tried. Adopting the series grouping for two tubes, charged, the one with hydrogen, the other with argon, Kohlschütter finds, in confirmation of his previous results, that 20 times more Pt was volatilised in argon than in hydrogen. Much depends upon the induction apparatus, however, and it results that with different induction apparatus of the same mean current intensity both the absolute amount of volatilisation and the volatilisation ratios for different gases may fluctuate considerably. The probable cause of the discrepancy would be that the volatilisation is not proportional to i, but proportional to i^n, and that n has different values for different gases. The fluctuations may completely mask the differences in the behaviour of different gases. **F. Fischer** and **O. Hähnel** (Ibid. pp. 433–437, Aug. 7, 1908) give particulars of the experiments already noticed, and repeat that they cannot accept Kohlschütter's view that the inactive gases become active in the vacuum tubes. **V. Kohlschütter** (Ibid. pp. 437–439, Aug. 7, 1908) replies further, and maintains that the differences are due to the different energy consumptions in the two series of experiments; a direct comparison is not possible, as the exact dimensions of the induction apparatus have not been given. He adheres to his opinion that a thermal and a chemical effect overlap; the thermal effect would predominate with the more volatile metals with which Fischer had chiefly experimented. H. B.

179. *Electrolytic Refining of Iron.* **E. F. Kern.** (Amer. Electrochem. Soc., Trans. 13. pp. 103–119; Discussion, pp. 120–125, 1908.)—The author reviews the literature on the subject, directing attention particularly to C. F.

Burgess and **C. Hambuechen** [Abstract No. 1918B (1904)], and describes experiments with various electrolytes, giving full particulars of constitution of bath, current potential and density, temperature, time, &c. Ferrous fluosilicates did not answer; they decomposed slowly and gave brittle deposits not free from silica. Good deposits are obtained from neutral solutions of 8 per cent. of $FeSO_4$; or 6 per cent. of Fe and 8 per cent. of Na as sulphates; or 8 per cent. of Fe ($FeCl_2$) and 4 per cent. of Na as chlorides at 40° or 60° C. When not in use, the electrolytes should be bottled up with a few pieces of iron, and should be protected from the air by a layer of vaseline or oil and acidified occasionally. The chloride gives the most flexible and, after heating, ductile and malleable iron; when the electrolyte contains ammonium sulphate, the iron is harder and less oxidisable, but seems to enclose some nitride or ammonium compound of iron and is not malleable. In the *discussion*, **J. W. Richards** thought that electrolytic refining of iron should be taken up industrially; **C. F. Burgess** doubted whether the laboratory results of days of experiments could be secured technically; **A. W. Smith** inquired whether the iron could further be improved by the addition of vanadium. **A. W. Betts** asked about the fluosilicate, and mentioned satisfactory experiments by B. Starbuck with ammonium chloride and ferrous sulphate. The **Author**, in reply, thought that vanadium would answer in subsequent metallurgical treatment, but not as an addition to the bath. Further experiments by A. P. Frapwell had, in 8 weeks, given a good iron deposit, ¾ in. in thickness, from neutral iron-sodium chloride. H. B.

180. *Electrolytic Chlorination of the Salts of Organic Acids.* **J. K. H. Inglis** and **F. Wootton.** (Chem. Soc., Journ. 93. pp. 1592–1594, Sept., 1908.)—An account of the preliminary investigation of the conditions necessary for electrolytic chlorination and bromination. With a solution of potassium benzene sulphonate and potassium chloride forming the anolyte in a porous pot (anode of Pt), a mixture of the monochloro-, dichloro-, and trichloro-sulphonates was obtained as substitution products, together with a mixture of trichloro- and tetrachloro-*p*-benzoquinone as oxidation products. With potassium bromide instead of potassium chloride, tetrabromo-*p*-benzoquinone was formed, but no bromosulphonic acids. [See Abstracts Nos. 1157 (1901) and 280 (1905).] T. S. P.

181. *Behaviour of Calcium and Sodium Amalgams as Electrodes in Solutions of Neutral Salts.* **H. G. Byers.** (Amer. Chem. Soc., Journ. 30. pp. 1584–1586, Oct., 1908.)—By means of a special arrangement the e.m.f.'s of calcium and sodium amalgams have been measured against solutions of their respective chlorides. The differences between the potentials against normal, tenth-normal, and hundredth-normal solutions agreed approximately with those calculated from Nernst's formula; diluter solutions did not give satisfactory results. Further experiments were also made, using solutions of CaCl and NaCl respectively, which also contained one of the following electrolytes: KNO_3, KCl, $BaCl_2$, LiCl. The results clearly show that when amalgams are treated with solutions of salts of alkaline or alkaline earth metals replacement occurs, so that the e.m.f. measured corresponds to that of an electrode consisting in part of the amalgam of the metal of the added solution. The replacement of one metal by another in this manner was also proved chemically. T. S. P.

182. *Passivity in Acid Solution.* **O. Sackur.** (Zeitschr. Elektrochem. 14. pp. 607–618 ; Discussion, p. 618, Sept. 11, 1908. Paper read before the Deutsch. Bunsen-Gesell., May 30, 1908.)—The author describes a number of experiments on the anodic solution of nickel in sulphuric acid, which were made with the object of determining the conditions necessary for passivity in cases where the formation of a protecting layer of a difficultly soluble metallic compound is very improbable. The diluter the solution of sulphuric acid and the greater the current density, the more easily does the anode become passive. When Cl'- or Br'-ions are added to the sulphuric acid, the point at which the passive condition ensues is displaced in the direction of higher current density, and if enough halogen ions are added the Ni remains active. An increase in temperature favours the active condition. Even when Ni is in the passive condition a very small amount of it dissolves on the passage of the current ; this is especially the case at higher temperatures and in the presence of halogen ions. Various explanations of the passivity are discussed, the author favouring the idea that the passive state is dependent on the velocity of the reaction between the metal of the anode and the discharged anions. Only when the depolarisation of the anions by the metal is quicker than the rate at which they are brought to the anode by the current does the anode dissolve at a low potential and in accordance with Faraday's law. At present it remains undecided as to whether the reaction between the metal and the anions is a direct one, or whether it takes place in stages according to the scheme—

$$Me + 2H^{\cdot} = Me^{\cdot\cdot} + H_2 ;\ H_2 + O = H_2O,$$

the velocity of the second reaction determining the velocity of the process. [See Abstracts Nos. 681 (1906), 1748 (1907).] T. S. P.

REFERENCES.

183. *Determination of the Atomic Weight of the Simple Ponderal Substance, Pantogen.* **G. D. Hinrichs.** (Comptes Rendus, 147. pp. 797–800, Nov. 2, 1908.) —Theoretical considerations lead the author to the conclusion that the atomic weight of "pantogen" ($O=16$ or $C=12$) is equal to the excess of the atomic weight of hydrogen over unity. T. H. P.

184. *Special Steels.* **L. Guillet.** (Eng. Mag. 36. pp. 65–75, Oct., 1908.)—The types of special steels suitable for uses in which particularly high strength or resistance to shock or abrasion is demanded, and the special applications of particular alloy steels and the case-hardening of steels are discussed in detail, most of which has appeared in former papers. [See also Abstracts Nos. 152B (1906) and 133 (1907).] F. R.

185. *Binary Alloys.* **G. Tammann.** (Zeitschr. Vereines Deutsch. Ing. 52. pp. 1078–1088, July 4, 1908. Zeitschr. Elektrochem. 14. pp. 789–804, Dec. 4, 1908.) —Gives a general account of the methods of study of alloys ; and the table referred to in Abstract No. 294 (1908) resuming the properties of binary alloys is completed to date, with the addition of much information for each system by means of a series of symbols. The data are, with a few stated exceptions, from the work of the author and his numerous collaborators at the Inst. für anorg. Chemie, Göttingen. F. R.

186. *Relationship between the Volume Contraction and Refraction of Liquid Mixtures.* **V. F. Hess.** (Akad. Wiss. Wien, Sitz. Ber. 117. 2a. July, 1908. Ann. d. Physik, 27. 3. pp. 589–625, Nov. 18, 1908.)—The author discusses the relationship between volume contraction and refraction, and derives a fundamental formula for connecting the two properties. The original paper must be consulted for details.
F. J. B.

187. *Absorption of Radio-active Emanations by Charcoal.* **R. W. Boyle.** (Journ. Phys. Chem. 12. pp. 484–506, Oct., 1908.)—A more complete account of the work dealt with in Abstract No. 1632 (1908).

188. *Action of Aluminium Powder and Carbon.* **F. E. Weston** and **H. R. Ellis.** (Faraday Soc., Trans. 4. pp. 60–71; Discussion, pp. 71–73, July, 1908. Chem. News, 97. pp. 219–222, May 8, and pp. 233–234, May 15, 1908. Abstract.)—A detailed account of the work referred to in Abstract No. 153 (1908) is given. Since CH_4 was the only hydrocarbon evolved by the action of water or hydrochloric acid on the products of reaction it is concluded that the carbide is Al_4C_3, already described by Moissan.
F. R.

189. *Osmotic Pressure.* **J. E. Trevor.** (Journ. Phys. Chem. 12. pp. 141–154, March, 1908.)—A mathematical discussion in extension of Porter's recent paper. [Abstract No. 356 (1908).] **A. W. Porter.** (Ibid. pp. 404–405, June, 1908.)—Porter, referring to the mathematical deduction of the osmotic pressure of a solution given by Trevor, who used Gibbs' method, prefers the deduction already given by himself as being more easily understood.
A. F.

190. *Influence of Solvents on Rotation of Optically Active Compounds.* XIII. **T. S. Patterson.** (Chem. Soc., Journ. 93. pp. 1836–1857, Nov., 1908.)—This part deals with ethyl tartrate in aromatic nitro-derivatives and the influence of temperature-change on rotation in solution.

191. *Thermodynamic Calculation of Electromotive Forces.* **F. Halla.** (Zeitschr. Elektrochem. 14. pp. 411–414, July 24, 1908. From the Physikal.-chem. Inst. d. Univ., Berlin.)—The author applies the Nernst thermodynamic theorem to galvanic elements, expressing the heat of reaction and the e.m.f. as temperature functions. By using the results of Broensted for the e.m.f. of the elements—

$$\text{Ag} \mid \text{AgCl}\ \text{PbCl}_2\ \text{sat. soln.} \mid \text{Pb} \quad \text{and} \quad \text{Ag} \mid \text{AgCl}\ \text{Hg}_2\text{Cl}_2\ \text{sat. soln.} \mid \text{Hg}$$

complete agreement was found between the observed and calculated values of the heats of reaction.
F. J. B.

192. *Actinic Electrolysis.* **C. G. Schluederberg.** (Journ. Phys. Chem. 12. pp. 574–631, Nov., 1908.)—The author has investigated a number of chemical reactions which are influenced by light, to see if such influence can be duplicated electrolytically in accordance with the theory of Grotthus, as developed by Bancroft. The results are in general agreement with this theory; for details the original paper should be consulted.
T. S. P.

193. *Electrolytic Oxidation of some Hydroxybenzoic Acids.* **A. G. Perkin** and **F. M. Perkin.** (Chem. Soc., Journ. 93. pp. 1186–1197, July, 1908.)—An account of the electrolytic oxidation of gallic acid dissolved in various media; also a preliminary account of the oxidation of protocatechuic acid.
D. H. J.